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THESIS

USING AFQT TO TEST FOR GENDER DIFFERENCES IN SERVICES

by

John C. Gaster III

March 2016

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This study looks at gender differences in loss and promotion across services and over time using individual data from the Defense Manpower Data Center for two cohorts of enlisted military personnel that began their service in 2005 and in 2010. The primary research questions are as follows: Are there differences by gender in loss and promotion, and are the differences heterogeneous by service? Second, using the Armed Forces Qualification Test (AFQT) as a proxy for ability, are there heterogeneous gender differences by ability in loss. I find that females leave the service at a higher rate than males in both their first term and overall, with the highest female loss being seen in the Army and Marine Corps. While the FY2010 cohort had higher first-term female loss than did the FY2005 cohort, a female's propensity to leave was lower, meaning that while more females were leaving the armed forces overall, the likelihood of a female leaving over a male was smaller in the FY2010 cohort. Using the AFQT as a proxy for ability, higher-quality females in the FY2010 cohort are more likely to leave the Navy and the Army. Results also show that females promote at a slower rate than males do across all services until the higher paygrades and later years.

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USING AFQT TO TEST FOR GENDER DIFFERENCES IN SERVICES

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LIST OF ACRONYMS AND ABBREVIATIONS

AFQT	Armed Forces Qualification Test
AGCT	Army General Classification Test
ASVAB	Armed Services Vocational Aptitude Battery
DACOWITS	Defense Advisory Committee on Women in the Services
DMDC	Defense Manpower Data Center
DOD	Department of Defense
EAOS	End of Obligated Service
FY	Fiscal Year
GED	General Educational Development
MOS	Military Occupational Specialties
NLSY	National Longitudinal Survey of Youth
ODASD	Office of the Deputy Assistant Secretary of Defense
OLS	Ordinary Least Squares
OUSD	Office of the Under Secretary of Defense
PAY	Profile of American Youth
SPAR	Semper Paratus—Always Ready
WAAC	Women's Army Auxiliary Corps
WAC	Women's Army Corps
WASP	Women Airforce Service Pilots
WAVES	Women Accepted for Volunteer Emergency Services
WISR	Women in Service Review

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I would also like to thank my fantastic wife, Rebecca, for her patience and support throughout this process. It wasn't easy dealing with a two-year-old and a newborn, especially when I was off trying to understand the theory of labor economics or how to code variables in STATA, but she handled it like a champ.

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I. INTRODUCTION

The secretary of the Navy, Ray Mabus, stated in September 2014, “We don’t have enough women in either the Navy or Marine Corps,” and later connected the importance of having a strong, diverse force directly to women’s accession into military service (Defense Advisory Committee on Women in the Services [DACOWITS], 2015a, p. 1). Despite consistent growth from 7% of the total armed service members in the 1970s to 18% in 2015, women remain the most underrepresented demographic in the Navy (DACOWITS, 2015a). This trend is seen across all branches of the armed services, with women accounting for 15% of the active duty force in 2014. The military has set a target goal of increasing the overall representation of females to 20% by the year 2020 (Mankowski, Tower, Brandt, & Mattocks, 2015). The Navy has set its target goal for women higher, with the plan to have females represent 25% of the enlisted force (DACOWITS, 2015a).

In September 2015, DACOWITS convened for its quarterly meeting to discuss issues related to the recruitment and retention of women in the military and to make recommendations on policy to the Department of Defense (DOD). In that meeting, DACOWITS voted to recommend to the secretary of defense to set goals to increase the representation of women in the officer and enlisted ranks, using the pool of eligible women as the criteria for those goals as opposed to setting goals based on past representation or any estimates of propensity for women to join (DACOWITS, 2015b).

The DOD has yet to come out with a consistent policy setting the goals for each service, the closest thing being the *DOD Diversity and Inclusion Strategic Plan, 2012–2017,* which presents diversity as a strategic imperative and stresses the importance of initiatives for retention (Department of Defense [DOD], 2012). While the DOD stresses that senior leadership should take concrete steps to promote diversity, there is no set roadmap or direction. Researchers at RAND, a research and public policy institution, argue that the lack of direction might be

due to the DOD having to implement its diversity strategy across all services with both active duty and civilian employees as well as all agencies (Lim, Haddad, & Daugherty, 2013). One example of the difficulty the DOD faces in promoting any fixed strategy across the armed services is the organizational difference of women being barred from Army and Marine Corps combat military occupational specialties (MOS) or any Special Forces, thus giving women fewer opportunities to excel. Another example is the Marine Corps physical fitness test being skewed toward upper body strength, something that damages female recruitment and retention. The researchers at RAND also explain that there is a general lack of understanding among those services and agencies on what the actual strategic goal is, making it difficult for each service and agency to set a goal or target to reach.

In my thesis, I study gender differences in loss and promotion across services and over time. Using individual data from the Defense Manpower Data Center, I analyze two cohorts of enlisted military personnel that joined military service in 2005 and in 2010.

My primary research questions are as follows: First, what explains the loss of enlisted personnel from the armed services? Are there differences by gender in loss and promotion, and do these differences persist across services? Second, using the Armed Forces Qualification Test (AFQT) as a proxy for ability, I test for gender differences in those who choose to leave. Are we retaining and promoting the highest-quality Sailors and Marines compared to the Army and Air Force?

With the push to increase female representation in the armed forces, my focus on gender differences is timely, and the results of this study may have useful policy implications for recruiting and retaining high-quality female recruits. Previous research found that female Navy officers and enlisted leave at a higher rate than males. Research has also found that females in the Navy are promoted at a slower rate than males in their early ranks, yet at a higher rate than males at the upper-ranks. It has also been shown that women, as well as minorities of both genders, perform worse on the AFQT than White males do, which may have

implications for the future career trajectories of these groups if the AFQT is an important determinant of success in the military.

Using two recently enlisted cohorts, I look to build on previous loss and promotion studies and profile those who choose to stay and those who choose to leave in order to create a conversation on how to actually reach those target numbers for female representation in the armed forces. My findings were similar to previous research in that females leave at a higher rate than males in both their first-term and overall, with the highest female loss being seen in the Army and Marine Corps. While the fiscal year (FY) 2010 cohort had higher first-term female loss than did the FY2005 cohort, a female's propensity to leave was lower, meaning that while more females were leaving the armed forces overall, the likelihood of a female leaving over a male was smaller in the FY2010 cohort. Using the AFQT as a proxy for ability, higher-quality females as well as married females in the FY2010 cohort are more likely to leave the Navy and the Army. Married females in the FY2010 cohort are also more likely to leave the Navy and the Army. Another significant finding is that females are promoted at a slower rate than males across all services until the higher paygrades and later years.

A. SCOPE OF THE THESIS

The purpose of this thesis is to study the characteristics of enlisted members who leave and are promoted in the armed forces, specifically testing for heterogeneous effects by gender. I use two data sets for the FY2005 and FY2010 cohorts. The data includes all enlisted members entering the Navy, Marine Corps, Army and Air Force in FY2005 and FY2010, and it follows the individuals from the time they enlist until the time they attrite, separate or until the end of FY2014. Using this data, I hope to bring insight into the issue of female retention and what it means to the overall strategy of increasing the representation of women in the military.

B. ORGANIZATION OF THE THESIS

This thesis contains six chapters. Chapter I is an introduction to the issue. Chapter II contains a background review, exploring the history of women in the military and the history of the AFQT. Chapter III is a literature review of previous retention and promotion studies as well as studies on the AFQT. Chapter IV discusses the data along with summary statistics, variables used and methodology for the linear fit, regression and survival analysis. Chapter V explains the results of the analysis. Chapter VI contains the conclusion and recommendations for future studies.

II. BACKGROUND

A. INTRODUCTION

In this chapter, I describe the history and evolving role of women in the military as well as look at the percentage growth of women across all branches of active duty service. I then describe the history of the AFQT and the role it plays as a tool in the military selection process.

B. WOMEN IN THE MILITARY

While women served in the Continental Army in the American Revolutionary War and in both the Northern and Southern armies in the Civil War in a traditional capacity, performing such duties as camp followers, nurses, cooks, and seamstresses, they have served in an official capacity since 1908, when the first 20 women reported to Washington, DC, to serve as nurses in the U.S. Navy Nurse Corps (Godson, 2001). The Navy later authorized women to officially enlist in the rate of yeoman on March 19, 1917. At the time, there were an estimated 11,275 female yeomen, designated as yeoman (F), or "yeomanettes" as they were commonly called, serving in the Navy, as well as 300 serving in the Marine Corps, representing 2% of the Navy's active duty ranks by the end of World War I (Ebert & Hall, 1999). The U.S. Army also recruited nearly 21,000 women to serve in the Army Nurse Corps in World War I along with roughly 230 female telephone operators in the Army Signal Corps (Women in the U.S. Army, n.d.).

In 1939, in order to fulfill the escalating manpower requirements of World War II, the British Navy created the Women's Royal Naval Service, an auxiliary to the Royal Navy, in which women filled roles as clericals, cooks, stewards, and messengers, relieving men of those jobs so they could be moved to fulfill combat roles (Godson, 2001). The United States also saw the growing manpower crisis of World War II and established the Women's Army Auxiliary Corps (WAAC) in 1941, which it used to fill desk jobs typically held by male counterparts (Godson,

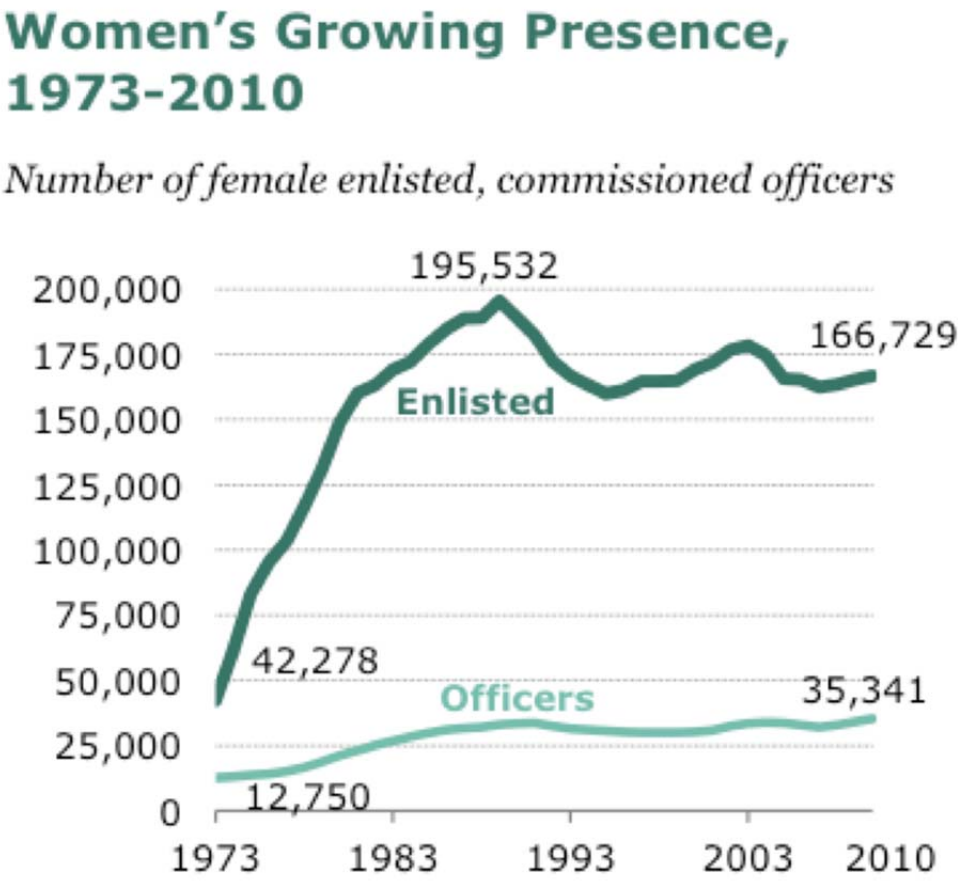
2001). The Navy followed suit with the creation of the Women Accepted for Volunteer Emergency Services (WAVES) program in 1942. This eventually became the Naval Women's Reserve and ushered in reserve branches for women in all of the other services, including the U.S. Coast Guard Semper Paratus—Always Ready (SPAR), U.S. Marine Corps Women's Reserve, and Women Airforce Service Pilots (WASP) (Godson, 2011). The U.S. Army also established the Women's Army Corps (WAC), eliminating the WAAC and its auxiliary-only status (Godson, 2011). By July 1945, the Naval Women's Reserve exceeded the previous projections of 1,000 officers and 10,000 enlisted with 8,475 officers, 73,816 enlisted, and roughly 4,000 in training (Godson, 2011).

In 1972, Congress passed the Equal Rights Amendment that granted equal rights and opportunities to Navy women, authorizing entry of enlisted women into all ratings, equal command opportunities, and no separate management or detailing between men and women (Ebert & Hall, 1999). The Equal Rights Amendment also paved the way for female enlisted and officers to be detailed to ratings and assignments onboard Navy ships and into Navy air squadrons as pilots, jobs that have been dominated by males for decades (Godson, 2011).

With gender roles in society continually evolving over the past 100 years, it is unsurprising that the number of female enlistees has steadily increased from 42,278 since conscription ended in 1973 to 166,729 in 2010, as shown in Figure 1 (Patten & Parker, 2011). Figure 2 displays the growing number of women in the military, with female officers increasing from 4.2% of all officers in 1973 to 16.4% in 2010 and female enlisted representing 2.2% in 1973 and 14.1% in 2010 (Patten & Parker, 2011). According to the DOD demographic profile of the military community for 2014, females accounted for 200,692 members of the active duty force, representing 15.1% of those serving in the active armed forces with 161,415 enlisted females and 39,277 female officers (Office of the Deputy Assistant Secretary of Defense for Military Community and Family Policy [ODASD(MC&FP)], 2014). Figure 3 provides the gender trends since 2000 as

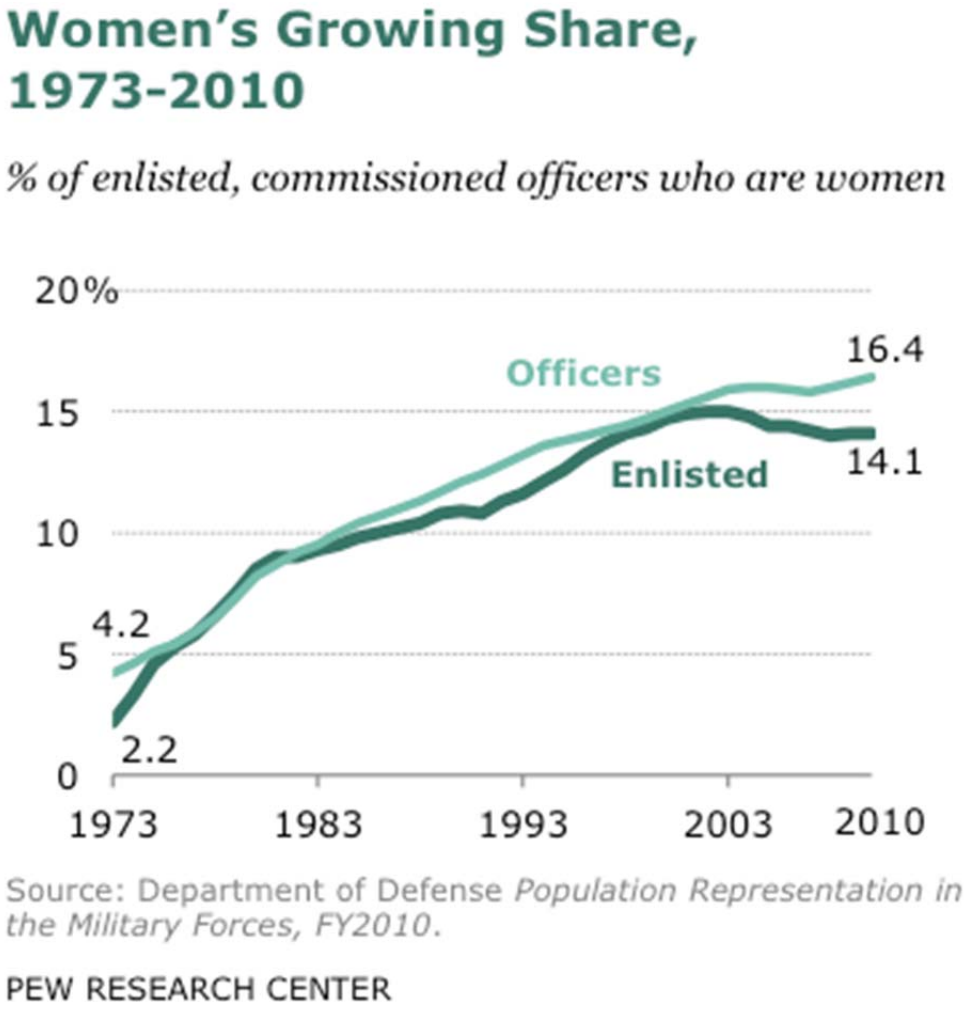
reported in the DOD demographic profile for 2014, with the percentage of total females (active and reserve) up slightly by 1.1% over 14 years, from 15.4% in 2000 to 16.5% in 2014.

Figure 1. Number of Women in the Military from 1973–2010



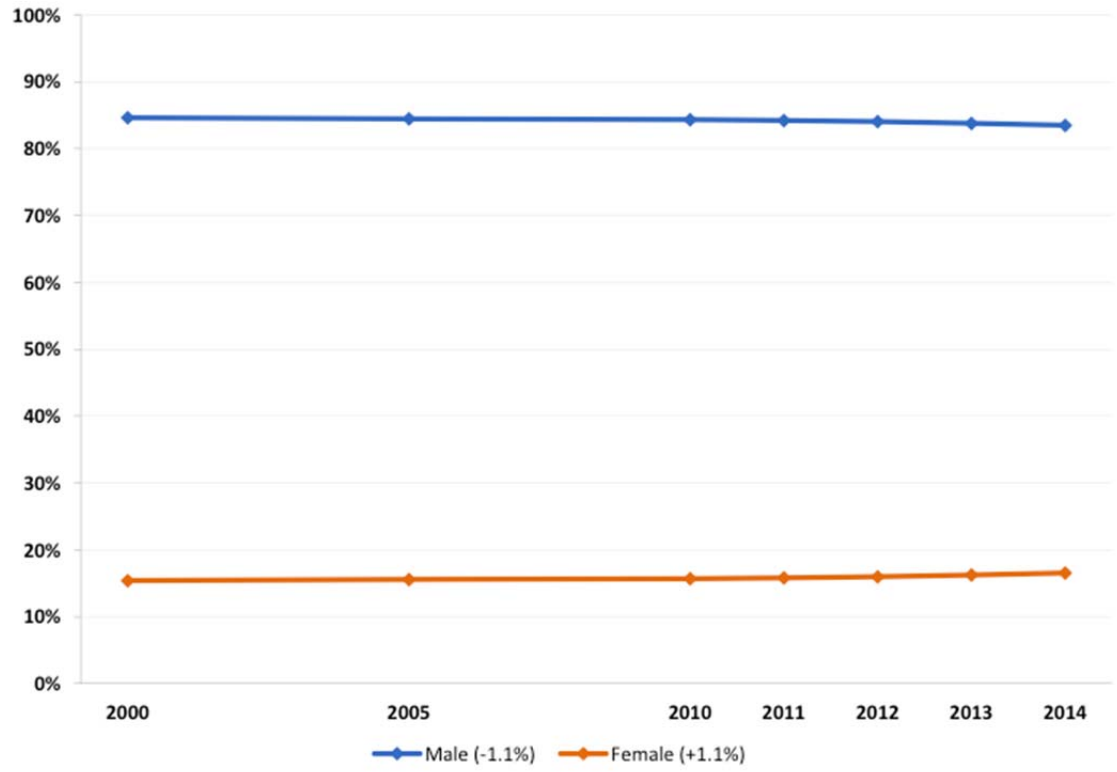
Source: Patten, E., & Parker, K. (2011). *Women in the U.S. military: Growing share, distinctive profile.* Washington, DC: Pew Research Center, p. 4.

Figure 2. Percentage of Military Enlisted and Officers Who Are Women



Source: Patten, E., & Parker, K. (2011). *Women in the U.S. military: Growing share, distinctive profile.* Washington, DC: Pew Research Center, p. 4.

Figure 3. Overall Gender Representation, 2000–2014



Note: Data are represented ONLY for the years indicated. Data for the years in between are NOT represented in this graph.
Source: DMDC Active Duty Military Personnel Master File (September 2000, 2005, 2010, 2011, 2012, 2013, 2014); DMDC Reserve Components Common Personnel Data System (September 2000, 2005, 2010, 2011, 2012, 2013, 2014)

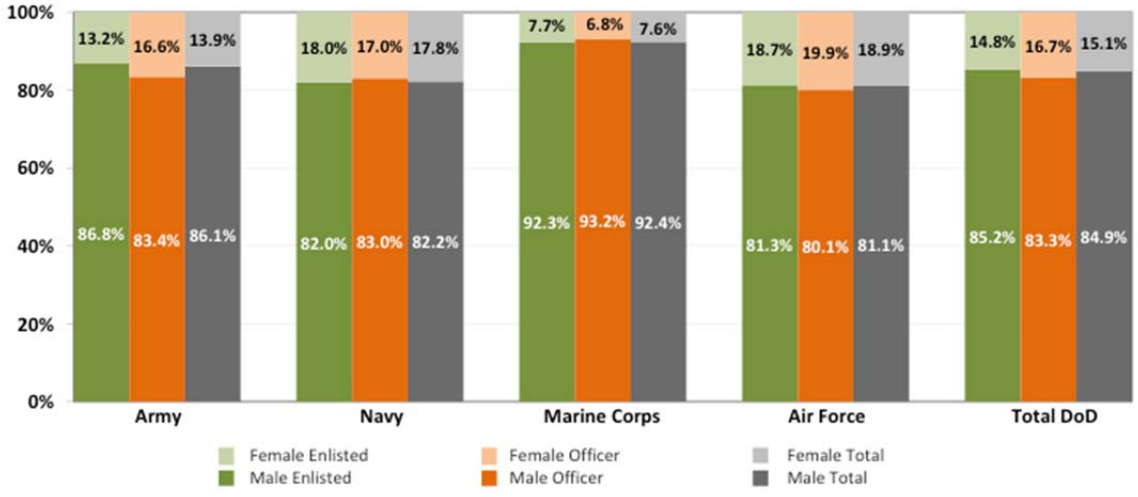
Source: Office of the Deputy Assistant Secretary of Defense for Military Community and Family Policy (ODASD[MC&FP]). (2014). 2014 demographics: Profile of the military community. Retrieved from http://download.militaryonesource.mil/12038/MOS/Reports/2014-Demographics-Report.pdf, p. 9.

The data in Table 1 shows that since 2010, the number of female enlisted has steadily fallen in both the Army and Air Force, while the number has steadily risen in the Navy and Marine Corps. Table 3 shows that since 2010, along with the number of females, the overall percentage of female representation in the military has fallen in both the Army and Air Force, showing that more males are joining and retaining, while fewer females are joining and more are leaving. Conversely, the overall percentage representation of female enlisted and officers, shown in Figure 4, has grown in both the Navy and Marine Corps since 2000, although the Marine Corps has only seen a 1.6% overall growth in both officer

and enlisted. Interestingly, the overall DOD percentage representation of female enlisted just started rising in 2014 after falling for 12 years, but the overall DOD percentage representation of female officers has been climbing since 2000, shown in Table 2 and Table 4. The steady rise of female officers in all services shows the commitment to placing women into leadership roles.

With overall female representation in the Armed Forces slowly on the rise, special care has been taken to ensure that women are given every chance to excel in the military. In 2012, a report to Congress regarding the Women in Service Review (WISR) concluded that while there was “no indication of females having less than equitable opportunities to compete and excel under current assignment policy” (Office of the Under Secretary of Defense for Personnel and Readiness [OUSD(P&R)], 2012, p. 4), the recommendation was to allow the assignment of women to “select units and positions (for Army, Navy, and Marine Corps) whose primary mission is to engage in direct combat on the ground” (OUSD[P&R], 2012). A 2012 RAND study quantified that in FY2011, 252,695 authorized positions, representing 21% of all authorized billets or occupations, were closed to women (Asch, Malchiodi, & Miller, 2012). Following the recommendations of the 2012 WISR report, Secretary of Defense Ash Carter announced in September 2015 that all rates, including those tied to combat positions, would be opened to female volunteers (Carter, 2015).

Figure 4. Percentage of Active Duty Enlisted Members and Officers by Service Branch and Gender 2014



Note: Percentages may not total to 100 due to rounding.
Source: DMDC Active Duty Military Personnel Master File (September 2014); Bureau of Labor Statistics (2014)

Source: Office of the Deputy Assistant Secretary of Defense for Military Community and Family Policy (ODASD[MC&FP]). (2014). 2014 demographics: Profile of the military community. Retrieved from http://download.militaryonesource.mil/12038/MOS/Reports/2014-Demographics-Report.pdf, p. 20.

Table 1. Number of Active Duty Male and Female Enlisted by Service Branch 2000–2014

	Army		Navy		Marine Corps		Air Force		Total DoD	
Year	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
2000	339,081	62,491	271,333	42,750	145,539	9,499	227,960	54,344	983,913	169,084
2005	348,079	57,196	261,275	43,698	151,195	9,849	221,207	54,906	981,756	165,649
2010	407,126	60,411	227,307	43,153	169,003	12,218	212,492	50,947	1,015,928	166,729
2011	403,631	60,255	223,036	43,896	166,798	12,363	213,042	50,301	1,006,507	166,815
2012	389,848	57,460	216,673	44,457	164,296	12,633	214,048	49,752	984,865	164,302
2013	373,422	55,681	218,986	46,991	161,784	12,826	212,664	49,111	966,856	164,609
2014	352,840	53,859	219,080	48,079	154,196	12,781	203,408	46,696	929,524	161,415

Note: Excludes cases where gender was not reported.
Source: DMDC Active Duty Military Personnel Master File (September 2000, 2005, 2010, 2011, 2012, 2013, 2014)

Source: Office of the Deputy Assistant Secretary of Defense for Military Community and Family Policy (ODASD[MC&FP]). (2014). 2014 demographics: Profile of the military community. Retrieved from http://download.militaryonesource.mil/12038/MOS/Reports/2014-Demographics-Report.pdf, p. 21.

Table 2. Number of Active Duty Male and Female Officers by Service Branch 2000–2014

	Army		Navy		Marine Corps		Air Force		Total DoD	
Year	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
2000	66,085	10,791	45,472	7,816	16,987	930	57,202	11,819	185,746	31,356
2005	68,766	12,442	45,064	7,816	17,699	1,093	59,777	13,470	191,306	34,821
2010	79,346	15,096	44,447	8,232	20,116	1,275	53,838	12,363	197,747	36,966
2011	81,791	15,760	44,689	8,520	20,537	1,328	53,187	12,291	200,204	37,899
2012	82,714	16,035	44,515	8,694	20,533	1,358	52,525	12,487	200,287	38,574
2013	82,743	16,224	44,866	8,995	19,863	1,375	52,106	12,692	199,578	39,286
2014	81,432	16,199	45,192	9,248	19,488	1,426	49,945	12,404	196,057	39,277

Note: Excludes cases where gender was not reported.
Source: DMDC Active Duty Military Personnel Master File (September 2000, 2005, 2010, 2011, 2012, 2013, 2014)

Source: Office of the Deputy Assistant Secretary of Defense for Military Community and Family Policy (ODASD[MC&FP]). (2014). 2014 demographics: Profile of the military community. Retrieved from http://download.militaryonesource.mil/12038/MOS/Reports/2014-Demographics-Report.pdf, p. 21.

Table 3. Percentage of Active Duty Male and Female Enlisted by Service Branch 2000–2014

	Army		Navy		Marine Corps		Air Force		Total DoD	
Year	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
2000	84.4%	15.6%	86.4%	13.6%	93.9%	6.1%	80.7%	19.3%	85.3%	14.7%
2005	85.9%	14.1%	85.7%	14.3%	93.9%	6.1%	80.1%	19.9%	85.6%	14.4%
2010	87.1%	12.9%	84.0%	16.0%	93.3%	6.7%	80.7%	19.3%	85.9%	14.1%
2011	87.0%	13.0%	83.6%	16.4%	93.1%	6.9%	80.9%	19.1%	85.8%	14.2%
2012	87.2%	12.8%	83.0%	17.0%	92.9%	7.1%	81.1%	18.9%	85.7%	14.3%
2013	87.0%	13.0%	82.3%	17.7%	92.7%	7.3%	81.2%	18.8%	85.5%	14.5%
2014	86.8%	13.2%	82.0%	18.0%	92.3%	7.7%	81.3%	18.7%	85.2%	14.8%

Note: Percentages may not total to 100 due to rounding.
Source: DMDC Active Duty Military Personnel Master File (September 2000, 2005, 2010, 2011, 2012, 2013, 2014)

Source: Office of the Deputy Assistant Secretary of Defense for Military Community and Family Policy (ODASD[MC&FP]). (2014). 2014 demographics: Profile of the military community. Retrieved from http://download.militaryonesource.mil/12038/MOS/Reports/2014-Demographics-Report.pdf, p. 22.

Table 4. Percentage of Active Duty Male and Female Officers by Service Branch 2000–2014

	Army		Navy		Marine Corps		Air Force		Total DoD	
Year	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
2000	86.0%	14.0%	85.3%	14.7%	94.8%	5.2%	82.9%	17.1%	85.6%	14.4%
2005	84.7%	15.3%	85.2%	14.8%	94.2%	5.8%	81.6%	18.4%	84.6%	15.4%
2010	84.0%	16.0%	84.4%	15.6%	94.0%	6.0%	81.3%	18.7%	84.3%	15.7%
2011	83.8%	16.2%	84.0%	16.0%	93.9%	6.1%	81.2%	18.8%	84.1%	15.9%
2012	83.8%	16.2%	83.7%	16.3%	93.8%	6.2%	80.8%	19.2%	83.9%	16.1%
2013	83.6%	16.4%	83.3%	16.7%	93.5%	6.5%	80.4%	19.6%	83.6%	16.4%
2014	83.4%	16.6%	83.0%	17.0%	93.2%	6.8%	80.1%	19.9%	83.3%	16.7%

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C. ARMED FORCES QUALIFICATION TEST

Since World War I, the military has used some form of aptitude test to screen potential enlisted military recruits. The goal of such aptitude tests is two-fold. First, they give commanders a crude measure of individual ability that is not easily observed. Second, they help commanders assign individuals to specific occupations based on their test performance. The tests also screen for individuals who are perhaps not functionally literate and have poor English skills or lack the ability to follow basic orders (Sellman, 2004). As noted by Eitelberg, Laurence, Waters, and Perelman (1984), "The fundamental purpose of entry screening, however, was the elimination of 'bad risks' or men who could not meet the 'severe demands of war', and the selection of those who could be trained in the shortest possible time." With the exception of the Army General Classification Test (AGCT) during World War II, historically each service branch—Navy, Marine Corps, Army and Air Force—have retained its individual aptitude tests for screening.

Created in 1950 and implemented in conjunction with the Selective Service System, the Armed Forces Qualification Test (AFQT) was the result of Congress mandating that the DOD measure and report the quality of its recruits

(MaCurdy & Vytlacil, 2003). Modeled after the AGCT, the AFQT was created specifically to be a screening tool unlike other service aptitude tests that were used to not only screen for aptitude, or ability to learn, but also used to assign a new recruit a military occupation (Sackett, Eitelberg, & Sellman, 2009). The modern AFQT is a compilation of four sections of the Armed Services Vocational Aptitude Battery (ASVAB), a test created by the DOD in 1974 for all services to screen and assign occupations (Sellman, 2004). The ASVAB is split into ten subtests; two subtests test for verbal skills: Word Knowledge (WK) and Paragraph Comprehension (PC); two subtests test for mathematics skills: Arithmetic Reasoning (AR) and Mathematics Knowledge (MK); and the remaining six subtests test science and technical knowledge: General Science (GS), Electronics Information (EI), Auto Information (AI), Shop Information (SI), Mechanical Comprehension (MC), and Assembling Objects (AO).

As mentioned by Eitelberg et al. (1984), the AFQT is just a composite of the ASVAB WK and PC and AR and MK tests. For classification and reporting purposes, AFQT results have been split into five categories, shown in Table 5 along with the percentage of youth that falls into each category.

Table 5. AFQT Categories by Corresponding Percentile Score Ranges and Percentage of Civilian Youth Population

AFQT Categories	Percentile Score Range	Percent of Civilian Youth
I	93-100	8
II	65-92	28
IIIA	50-64	15
IIIB	31-49	19
IV	10-30	21
V	1-9	9

Source: Sellman, W. S. (2004). Predicting readiness for military service: How enlistment standards are established (Commissioned paper prepared for the National Assessment Governing Board). Washington, DC: U.S. Department of Education, p. 6.

Potential recruits who score in Categories I and II are reported to have “above average” cognitive ability; those in Category III are assigned average cognitive ability; those in Category IV have below average cognitive ability; and those in Category V, markedly below average cognitive ability (Sackett et al., 2009).

Title X dictates how many military recruits can be selected in each AFQT category, with recruits from Category V and those with no high school degree in Category IV barred from enlisting in any branch of service (MaCurdy & Vytlacil, 2003). The military is currently only allowed to accept 4% of recruits from those with a high school degree who are in Category IV (MaCurdy & Vytlacil, 2003). The acceptance or rejection of Category IV recruits can be seen as a force-shaping tool, as the quota allowed has shifted over time (Eitelberg et al., 1984). Category III is split at the 50th percentile with two subcategories, A and B, allowing for reporting of scores above and below the mean (Sackett et al., 2009). The AFQT has proven to be an excellent predictor of recruit quality, with many quantitative studies showing a link between performance on the AFQT and subsequent job performance, promotion, retention, and attrition.

Since its creation in 1974, the AFQT used as a reference population the approximately 12 million male enlisted and officers serving on active duty on December 31, 1944. This cross section of the population near the end of World War II was assumed to be representative of America’s youth population for over 30 years (Sackett et al., 2009). This reference group can be seen as problematic as demographics in the United States and the military shifted drastically during that 30-year time period. Studies by DOD psychometricians later showed that due partially to this variation in demographics, AFQT score conversion tables were calibrated incorrectly, leading to score inflation in applicants in the lower ability range and allowing approximately 360,000 individuals who did not meet minimum standards to enlist from 1976 to 1980 (Sackett et al., 2009).

In order to correct for these calibration errors and update the reference population, the Profile of American Youth (PAY) study was commissioned by the

DOD in 1980 (PAY80) and again in 1997 (PAY97) to administer the ASVAB to study the question of recruit quality and quantity in a post-draft military (Sackett et al., 2009). In addition to the AFQT scores obtained from the ASVAB, the study also included sociodemographic information, including "gender, race/ethnicity, level of education, mother's education (as a proxy for socioeconomic status) and geographic region" (Sackett et al., 2009).

While researchers and analysts expected large racial differences in AFQT scores between Blacks and Whites as well as gender differences between men and women, the DOD was careful about introducing these results to the general public. It met with minority groups to discuss the context and explain that the results were no different than those from previous studies (Sackett et al., 2009). These precautions did not prevent the media storm and controversy that followed, although it did provoke a number of thoughtful studies analyzing the AFQT and what the Black and White and male and female gaps meant in the context of the PAY80 and PAY97 data. Most of those studies found that Blacks, Hispanics, and females scored significantly lower on the AFQT than White males, although most of those studies also attributed the lower scores to other socioeconomic and behavioral variables.

D. CONCLUSION

When considering the role women play in the military today, it is important to remember how far they have come and think about what can be done to ensure their presence in the armed forces continues to rise. It is also important to understand the history of the AFQT and how that test is used to ensure that military recruits are of the highest quality. In the next section, I look at studies that have been conducted regarding the role of gender in attrition and promotion in the military. I also look at studies that examine the AFQT, PAY80, and PAY97 and how they are being used to study race and gender differences in testing as well as differences in wages.

III. LITERATURE REVIEW

A. INTRODUCTION

In this chapter, I examine studies that focused on the role of gender and race in loss and promotion in the military. I also examine studies that have focused on the various uses of the AFQT, including gender and race differences and how those differences reflect on AFQT scores.

B. MILITARY FEMALE RETENTION STUDIES

Though many studies have examined retention rates among female officers and enlisted, I focus on the findings of three studies. These are discussed in the following sections.

1. Asch, Malchiodi, and Miller (2012)

The RAND Corporation has conducted multiple studies examining the role of gender and race in officer career progression and promotion. The most recent update was completed by Asch, Malchiodi, and Miller in 2012 using longitudinal data from the Defense Manpower Data Center (DMDC) from 1988 to 2010 for all officers entering military service at the rank of O1 (which excludes staff corps occupations in medical, legal, and religious affairs).

Using probit to estimate gender and race differences in career progression, the authors found that women, regardless of race or service, were less likely to be promoted and less likely to be retained until their O6 milestone was reached. After that point, women were more likely to be promoted. Their results also showed that women were less likely to be promoted to O2, O3 and O4 than White males, with the exception of Black females, and the percent of White females who stayed for promotion to O4 was 10.9 percentage points less than White males; that is, a White female was 10.9% less likely than a White male to stay until reaching the milestone for O4 promotion. Being that the promotions from O1 to O2 to O3 are automatic with time-in-rate fulfilled, it also shows that White females are leaving

the service before their two- or four-year milestone promotions, and even those that stay to make O3 leave before they are promotable to O4. The authors explain that the lower percentage of females eligible for promotion to O4 and actually promoting to O4 is in part due to higher attrition at the lower ranks, a finding that is consistent with previous RAND studies.

One problem with this study is that it is difficult to find any other study to compare it to in order to observe and react to trends. While this study is an update of a previous RAND study, the authors have access to monthly and quarterly promotion and attrition data for the armed forces, as opposed to the previous study that only had access to yearly data, making it difficult to make direct comparisons. It is also difficult to make a direct comparison to the previous study because the number of women and minorities has significantly risen since the other study. Another problem with the study is the lack of data, especially data that would allow one to look at ability or performance to understand why one is chosen to promote or makes the decision to leave the service. While the authors include the tables that demonstrate the differences in promotion between the services, it is interesting that they don't discuss those differences and instead discuss overall results. They also don't specifically look at female loss or promotion per service branch, just overall female loss or promotion.

2. Golan, Greene, and Perloff (2010)

Golan, Greene, and Perloff (2010) looked at the difference between promotion and retention in the U.S. Navy by race and sex using two bivariate probit models; one for the Sailor's reenlistment decision and another for the Navy's promotion decision. This study had access to enlisted data from 1997 to 2008 for ranks E3 to E7 that included AFQT scores, which were used as a proxy for ability, as well as evaluation scores, which measured actual current and past performance. The study found that Sailors with higher AFQT scores were more likely to be promoted but also more likely to leave; also, females with higher AFQT scores were more likely to be promoted than men with higher AFQT

scores. Similar to the RAND officer study, the authors found that females were less likely than males to promote at the lower ranks, from E3 through E5, but more likely than males to promote at the higher ranks, E6 and E7. While females were more likely to promote at the higher ranks, they were less likely than males to stay in the Navy and more likely to leave. Other findings include sailors with some post–high school education were more likely to be promoted and sailors with only high school degrees were more likely to stay in the Navy.

While the authors had access to over 21 skill groups with many job occupations and rates, they decided to solely look at the administration skill group, which includes yeomen, personnel specialists, Navy counselors, musicians, mass communication specialists, and legalman. One obvious problem here is the lack of job diversity, which does not reflect the actual enlisted population of the U.S. Navy. By choosing one skill group, you lose out on four vastly different communities, including aviation and surface, subsurface, and special warfare, each with varying levels of technical skill sets, deployment experiences (as some of the rates in administration are non-deployable or limited in their deployment opportunities), and promotion pipelines. The research also does not take into account Selective Reenlistment Bonuses (SRBs), which may affect the reenlistment decision, nor does it control for “closed communities,” or occupations and rates that are closed or limited to female enlisted Sailors. Finally, while the authors make many good observations based on their probit models, they don’t actually look at the characteristics of the females who are leaving the service. It is also difficult to quantify their results because they only looked at one branch as opposed to all of them.

3. Seker and Ibis (2014)

While this thesis from the Naval Postgraduate School specifically looks at the effect of different enlistment ages on first-term attrition, the authors also take a good look at the characteristics of female first-term attrites across all services. Seker and Ibis (2014) use a data set from the Defense Manpower Data Center

(DMDC) and examine three cohorts, 1995, 2000, and 2013, where females represented 16% of the Army observations, 14% of the Navy observations, 23% of the Air Force observations, and 7% of the Marine Corps observations. Using two separate probit models for each service, they use attrition as a dependent variable for one model and attrition due to "character disorder," as shown by inter-service separation code, as the dependent variable for the second model. They use age as the independent variable with various descriptive dummy independent variables that look at race, gender, marital status, education level, and AFQT category.

Results for both probit models show that overall female enlisted attrition is higher than overall male enlisted attrition for all services, and first-term enlisted female attrition is higher than first-term enlisted male attrition for all services with the exception of the Navy, where it was statistically insignificant. The basis of this thesis was whether they could predict if an enlistee would attrite due to age, and the results showed that while statistically significant, age had a varying degree of impact on attrition that depended on service branch.

One problem with the study is that the authors kept observations for independent variables that were listed as unknown or missing, seemingly for the purpose of increasing the number of observations. Independent variables that included this "bad" data and include an "unknown" dummy are AFQT, education, marriage, and race, thus making it difficult to actually interpret their results. Another problem is the inclusion of the Hispanic dummy variable, which only included data for the years 1995 to 1999 but was included in all regressions.

C. AFQT STUDIES

In this section I examine the results of two studies that focus on the use of the AFQT score and the gender differences in those scores.

1. Blackburn (2004)

In this study, Blackburn (2004) uses data from the National Longitudinal Survey of Youth (NLSY) 1979 cohort, as well as ASVAB and AFQT data, to

examine the racial and gender differences in average wages by looking at the impact of each individual subsection of the ASVAB as opposed to the overall AFQT score. Blackburn (2004) initially uses an ordinary least squares (OLS) estimation of regressions with AFQT score as the dependent variable and a race/ gender indicator and age as independent variables. He estimates a second OLS model, adding in an education variable and using the highest grade completed as a control. In both of the regressions, there was a significant difference in the performance of women compared to men, including a gender difference within each race category.

When the regression is broken down into ASVAB subsections, the differences start to become more apparent, with the largest difference being between Black and Hispanic men and women on average performing worse on word knowledge than White men. The author finds that "women perform better on paragraph comprehension than men but perform worse on both mathematical subtests, although they do score better on the numerical operations subtest than men do" (Blackburn, 2004, p. 561). Blackburn (2004) then uses NLSY data to add in family background controls like parents' education, magazine and newspaper subscriptions, library card possession, and number of siblings. He explains that his findings are similar to previous ones where family background variables do little to explain male and female differences but do explain a large portion of Black and White differences. Finally, he looks at a log (wage) equation, specifically looking at gender and race differences, and concludes that the use of the overall AFQT score does very little to explain the wage gap, but including individual ASVAB subtests has a substantial impact on explaining that wage gap.

One problem with this study is that the use of NLSY data from 1979, the same cohort used for PAY80, represents data that is over 20 years old at this point. No effort was made to compare the 1979 cohort AFQT or ASVAB scores to the cohort that is represented by the PAY97 cohort. One explanation for using the older data set is that the 1979 cohort represents the first time an aptitude test was given to a nationally represented sample, something that the 1997 cohort

only replicated (Sackett et al., 2009). Another explanation is that the data in the 1997 cohort just isn't as controversial as the NLSY data was in 1979 and didn't spawn as many thought-provoking research papers (Sackett et al., 2009). Another problem acknowledged by the author is the use of an education dummy variable on wages without looking at individual tests, something that might have an overall higher impact on wages than an education criteria.

2. Kanarek (2014)

Building off of other studies that have focused on the correlation between the NLSY 1979, AFQT scores, and the wage gap between races and gender, Kanerek specifically looks at background factors, both direct and indirect, that affect AFQT scores. The research is based on human capital theory, in which an AFQT score is a product of human capital investments. As opposed to most of the prior research, including the previously discussed research by Blackburn (2004), the author looks at the NLSY 1997 cohort, believing it is a natural fit for the study.

Two OLS regression models were run in this study, both using AFQT as the dependent variable. The first OLS model specifically focuses on the direct effects or the background of the individual observations, including variables like education at time of AFQT, race, poverty, mother's education, gender, age, "urban" or other location, and emotional or physical impairment. The second OLS model uses all of the background variables from the first model but adds in the indirect effects with variables like how many days they were absent from school, whether they feel safe at school, their overall optimism, how they feel their peers perceive them, and if they have any arrests.

The gender results from both OLS regressions show that males actually do worse on the AFQT than females, a finding contrary to most studies. Kanerek (2014) explains in a footnote that she predicted the gender results for the male variable would be negative, explaining that males tend to perform worse on standardized tests than females when controlling for other factors. The race results again show a large negative effect for both Hispanics and Blacks,

something that most studies have found and explained as a function of background socioeconomic functions. One significant finding proving the human capital theory, along with the direct and indirect effects presented in this paper, is the magnitude of effect that the impairment and days absent variables had on AFQT scores, showing the correlation between having a physical or mental impairment and missing school having a major effect on AFQT scores.

One area of improvement, for this study, which the author also acknowledged, would be to break the indirect effects down further, that is, to look at the components of each variable. One example is to look at family structure and how big a family is. Another example is to look at a mother's education, a significant determinate of AFQT results, in light of whether a father figure was present. One shortcoming of this study is echoed by Blackburn's study: Using years of education as a dummy doesn't do much to show the effect of education on the AFQT as there are many factors, including school quality that could also be correlated to AFQT scores.

D. CONCLUSION

As the DOD looks to increase the number of females serving in active duty military, it is important for researchers to continue to look at the characteristics of those who leave and those who promote and to study the characteristics and motivations that lead to that promotion and loss. It is also important to continue to research the factors that go into an individual's score on the AFQT, as that is the preliminary basis for military enlistment. While my research does not go into the factors that affect AFQT scores, I use the AFQT as a proxy for ability and use this as the basis for recruit quality and what it means for female loss from the armed forces. I also look at the characteristics of females that choose to leave across the services as well as the survival function for that gender group.

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IV. DATA AND METHODOLOGY

A. INTRODUCTION

In this chapter, I describe the data and the coding of the variables used in the econometric exercise. I later use these coded variables to test for gender differences in the military, specifically looking at loss and promotion as well as the characteristics of the women who choose to leave. After describing the data, I show descriptive statistics highlighting the differences between the cohorts and the military branches.

B. DATA

For the analysis, I obtained two separate data sets at the individual-month level from the Defense Manpower Data Center (DMDC) following two cohorts of enlisted personnel: those who enlisted in FY2005 and FY2010. The datasets follow these cohorts up to September 30, 2014. Both data sets include longitudinal data for all enlisted accessions to the Navy, Marine Corps, Army, and Air Force in their respective fiscal years (2005 or 2010) with annual data on these individuals up to FY2014. Thus, I follow each individual enlistee from the time that person enters his or her respective branch's boot camp to the time the enlistee attrites, separates or until September 30, 2014. While I know when an individual leaves the cohort, I do not know the reason for their attrition or separation. The raw FY2005 cohort has 160,774 individuals, while the raw FY2010 cohort file has 165,170 individuals.

1. FY2005 Cohort Data

When processing the FY2005 data, I dropped 25,556 individuals, or 15.9%, from the total FY2005 enlisted population because of missing variables. The majority of dropped individuals (17,240 observations, or 67% of those dropped) was due to coding errors because of missing branch of service. Other missing variables included no AFQT score being listed, which led to 3,322

dropped observations, and zero time in service, which led to six dropped observations. Because this study focused on enlisted active duty members, I dropped 4,988 individuals who were officers or warrant officers. Most of the officers appear in the data because of special programs in the Army where one joins as an E4 or E5 and is then automatically promoted to O2 or O3 once basic training is completed (usually promoted to a Medical Corps occupation code). I also dropped all observations in which an enlisted converted to officer or warrant officer through other commissioning programs, as their data stopped being recorded once commissioning showing a false attrite in their cohort.

2. FY2010 Cohort Data

When processing the FY2010 data, I dropped 20,925 individuals, or 12.67%, from the total FY2010 enlisted population because of missing variables. Similar to the FY2005 file, the majority of dropped individuals (13,780, or 61.9%) was due to coding errors because of missing branch of service. Other missing variables included no AFQT score being listed, which led to 5,178 dropped observations; zero time in service, which led to seven dropped observations; and incorrect listing of a female in a closed occupation (special warfare), which led to one dropped observation. Because of the focus on enlisted active duty service members, I dropped 1,958 individuals who were officers and warrant officers.

C. VARIABLES

After dropping individuals with missing data, I was left with 135,218 individuals for the FY2005 cohort and 144,015 individuals for the FY2010 cohort. For these individuals, I constructed several variables. I begin by discussing the independent variables used in the analysis. Using the raw AFQT score, I put each individual into one of six dummy variables (I, II, IIIB, IIIA, IV, V) according to their percentile score range. To capture differences in education, I created five indicator variables for General Educational Development (GED) or alternative certificate, high school degree, some college, college degree, and master's degree or higher. Using AFQT category and education level, I created a dummy

variable to measure high quality recruits. The variable High Quality includes individuals that had an AFQT category of IIIA, IV, or V as well as a high school degree or higher. In accordance with DOD policy, only having a GED or alternate certificate does not make one a high quality recruit regardless of AFQT score.

I constructed four dummy variables for race: Hispanic, White (non-Hispanic), Black and other. Because of complications in the raw files with multiple variables for both ethnicity and race, and some files allowing one to self-select into multiple categories, I used Race 2005 and Ethnic 2005 as the basis for the dummy variables, using the 2005 version as the base year (as one can change or update race or ethnic designation over time). Using the Ethnic 2005 raw variable, I created the Hispanic dummy variable if Mexican, Puerto Rican, Cuban, Latin American with Hispanic, or Other Hispanic equaled 1. I created the White dummy variable if Race 2005 was White and my created Hispanic dummy did not equal 1. This allowed me to separate observations who designated their race as White but their ethnicity as Hispanic, separating those who designate as Hispanic into their own category. The Black dummy variable was created from the Race 2005 raw variable in which an observation was listed as Black or one of four Black mix categories and the Hispanic dummy did not equal 1, again to separate any observation that was designated as both Black and Hispanic. Finally, I create the Other dummy variable if Hispanic, Black and White did not equal 1, basically putting all other observations that selected any of the Asian, mix, or other categories into that dummy variable.

I also created a dummy variable for Females and separate dummy variables for Service for each individual in each year across both FY2005 and FY2010 cohorts, presumably to see if anyone converted from one service branch to another. There were no cases of an individual changing services, so I used the base year to create dummy variables for each branch of service; Service 2005 and Service 2010 were used to create variables for the Navy, Army, Air Force, and Marines. A Paygrade dummy for each year was created for both cohort files, with the FY2005 file having E1 through E7 and FY2010 having E1 through E6.

Marital status was provided in the raw data for all years in the file, and I used this data to create the dummy variable Married, which shows that an individual was married at first observation in 2005 or 2010. A dummy variable was created using an individual's home of record. I interacted the home of record variable with year as a control variable. Using this interaction, I hope to control for a state's unemployment rate over time that may influence an individual's desire to leave their service.

Using date of separation, Loss Year is the dummy variable created to encompass if anyone separated, or attrited, in either cohort during the time period. First, I created dummy variables for each individual year looking at whether an individual's separation date was during that fiscal year; October 1, 2004, to September 31, 2005, would be the first time period for Loss 2005. If an individual's separation date falls into that time period, then loss for that year will equal 1. If the separation date did not fall in that time period, or if there is no separation date listed, meaning the individual is still currently on active duty, then loss for that year will equal 0. In the 2005 cohort I have ten loss variables for years 2005 through 2014 and in the 2010 cohort I have five loss variables for years 2010 through 2014. I created a variable to encompass loss in all time periods for both the FY2005 and FY2010 data sets called Loss Cohort. If any of the individuals in the separate loss years had a value of 1, then they counted as an overall loss from the cohort. If an individual had a value of 0, then they were not counted as an overall loss from the cohort. I also separated loss into each individual service and called that variable Loss Service with four loss variables representing the four branches of service.

I created two variables to test for heterogeneous effects by gender. While I controlled for the direct impact of the AFQT and marital status in the analysis, the initial analysis did not test of differences by gender. So, I constructed an interaction variable defined as Female*Married, which measures the differential impact of marital status for female decision to leave. The second interaction is Female*AFQT, which measures if the impact of AFQT on attrition differs by

gender. Using AFQT as a proxy for ability, the Female*AFQT interaction will also show if a service branch is keeping the highest quality females.

D. SUMMARY STATISTICS

In this section, I present the summary statistics separately by cohort, specifically looking at demographics and AFQT distribution by gender.

1. FY2005 Cohort Data Demographics

After cleaning and coding, the FY2005 Cohort had 135,218 observations representing four active duty military branches. The Army has the highest frequency, with 51,316 observations representing 41.65%, and the Navy is second, with 32,889 observations representing 24.32%. The Marine Corps has 28,718 observations and the Air Force has 17,295, representing 21.24% and 12.79% respectively, as shown in Table 6. Males make up a majority of the observations for FY2005, with 115,338, and females make up 19,880 observations at 14.7% of the data set. While the Army has the highest number of female recruits in 2005 with 8,996, the Air Force has the highest percentage of females, with 21.98%. The Marine Corps has the lowest representation of females in the FY2005 cohort, with 1,899 females representing 6.61%. The Navy has the highest percentage of Blacks, with 19.20%, while the Marine Corps has the lowest at 6.69%. The Army has the highest percentage of Hispanics at 12.21%, with the Marine Corps slightly behind with 10.53%.

Table 6. FY2005 Cohort Gender Representation by Service

	Gender			
Service	**Male**	**Female**	**Total**	**Percent Female**
Army	47,320	8,996	56,316	15.97%
Air Force	13,493	3,802	17,295	21.98%
Marines	26,819	1,899	28,718	6.61%
Navy	27,706	5,183	32,889	15.76%
Total	115,338	19,880	135,218	14.7%

The Army has the highest average enlisted recruit age at 20.98 but the lowest average AFQT score at 59.81, while the Marine Corps has the lowest average enlisted recruit age at 19.26, and the Air Force has the highest AFQT average at 66.83. Figure 5 shows the frequency distribution of AFQT scores by gender for all services showing that overall, more women are scoring around the average while fewer are scoring in the higher categories compared to their male counterparts. Figures 6–9 show the frequency distribution of AFQT scores by gender for each individual service, again showing the trend of more females scoring near the average and fewer scoring in the higher categories. It is interesting to note that the service with the highest average enlisted recruit age, the Army, also has the highest married percentage at 19.13%, while the service with the lowest average enlisted recruit age, the Marine Corps, has the lowest married percentage at 6.69%, as shown in Table 7.

Figure 5. FY2005 AFQT Distribution by Gender for All Services

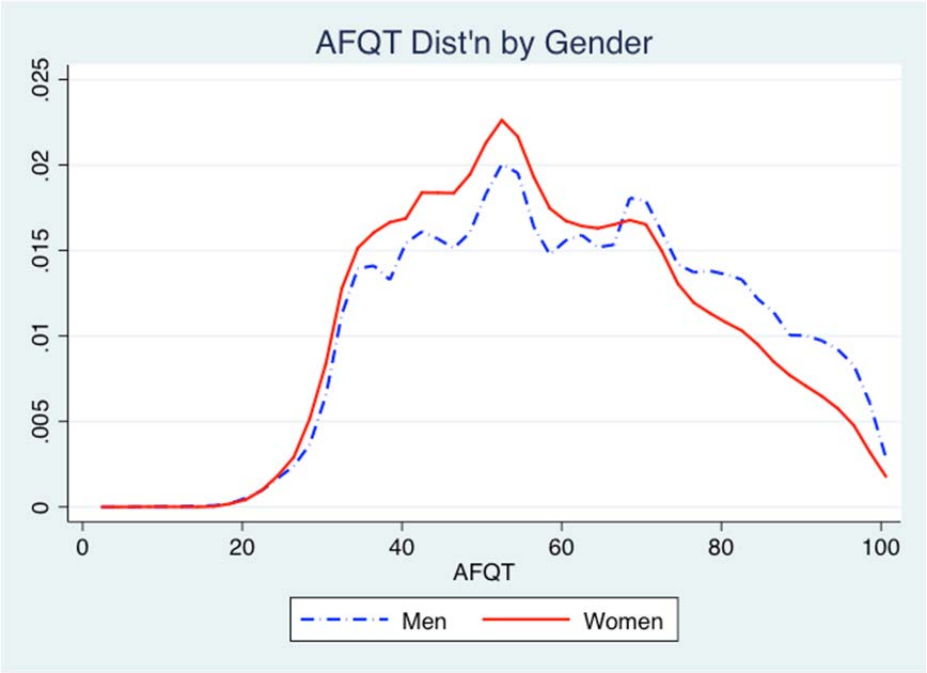


Figure 6. FY2005 AFQT Distribution by Gender for the Navy

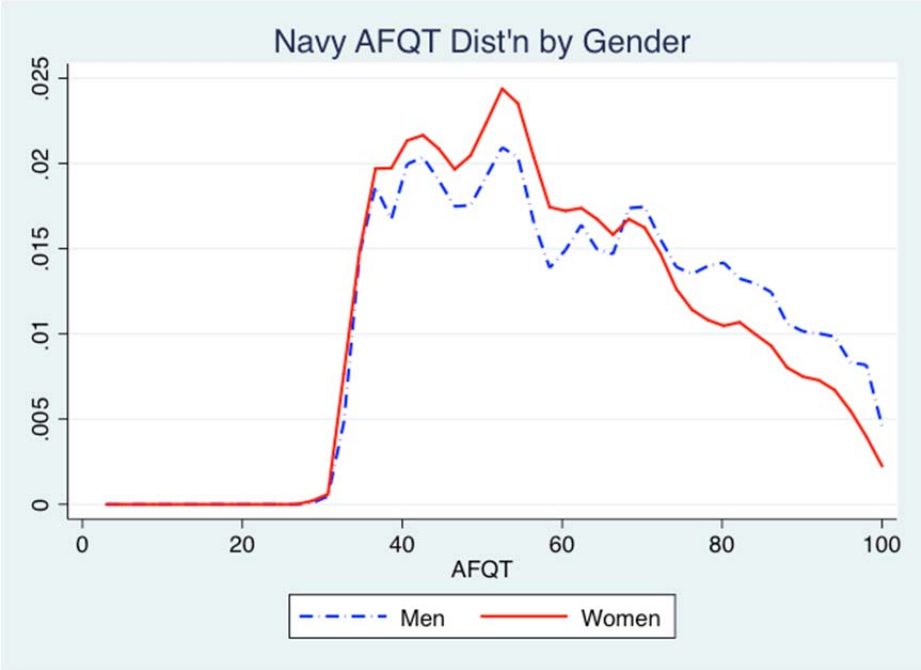


Figure 7. FY2005 AFQT Distribution by Gender for the Marine Corps

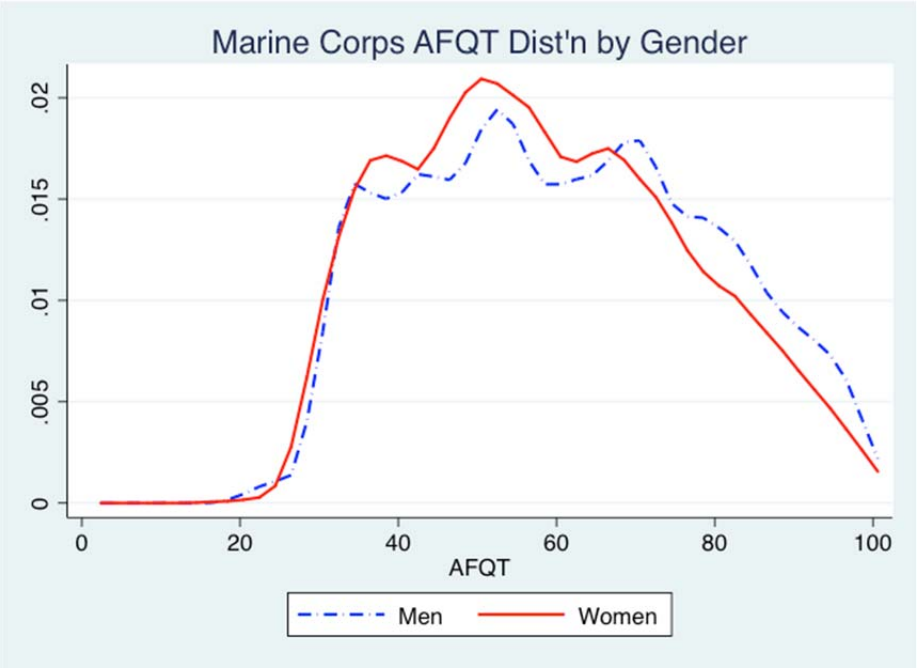


Figure 8. FY2005 AFQT Distribution by Gender for the Army

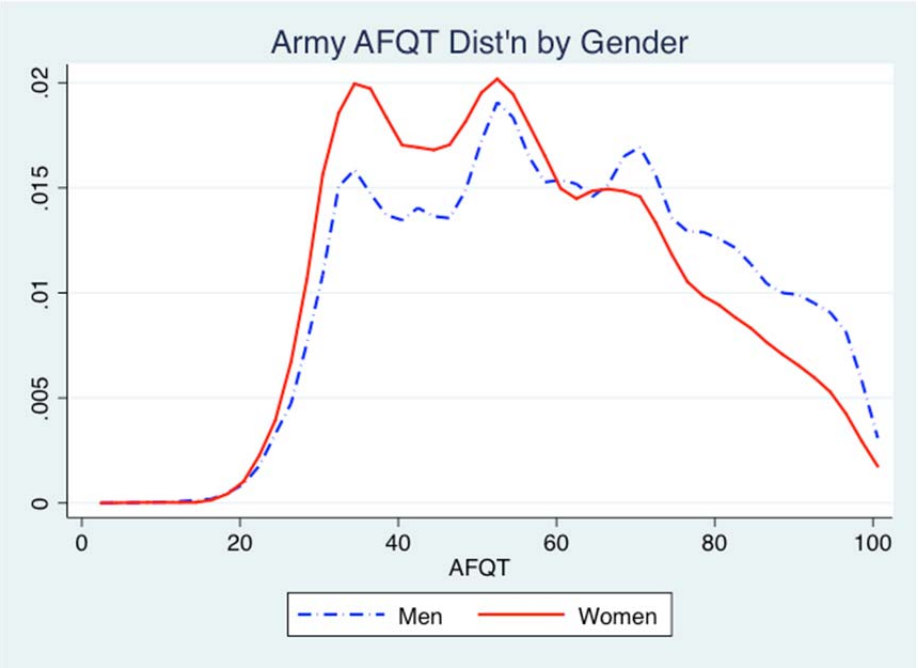


Figure 9. FY2005 AFQT Distribution by Gender for the Air Force

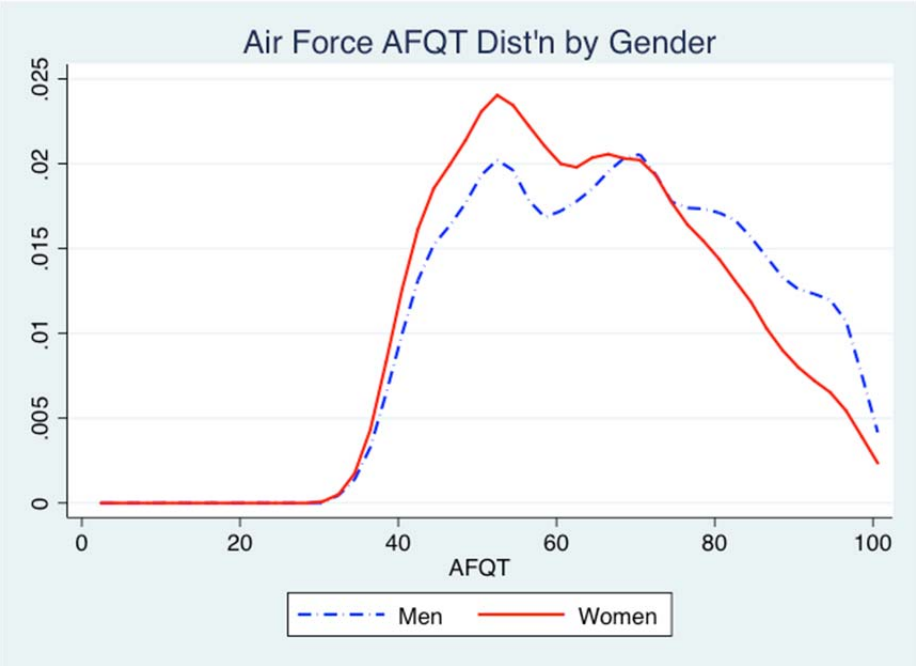


Table 7. FY2005 Cohort Summary Statistics

	Variable	N	Mean	SD
Army	Female	56316	0.16	0.37
	Age	56316	20.93	3.56
	Black	56316	0.14	0.35
	Hispanic	56316	0.12	0.33
	Married	56316	0.19	0.39
	AFQT	56316	59.81	19.75
Air Force	Female	17295	0.22	0.41
	Age	17295	19.80	2.07
	Black	17295	0.15	0.36
	Hispanic	17295	0.00	0.05
	Married	17295	0.13	0.34
	AFQT	17295	66.83	16.38
Marines	Female	28718	0.07	0.25
	Age	28718	19.26	1.97
	Black	28718	0.07	0.25
	Hispanic	28718	0.11	0.31
	Married	28718	0.07	0.25
	AFQT	28718	60.72	18.42
Navy	Female	32889	0.16	0.36
	Age	32889	19.96	2.72
	Black	32889	0.19	0.39
	Hispanic	32889	0.00	0.07
	Married	32889	0.10	0.30
	AFQT	32889	62.35	18.19

2. FY2010 Cohort Data Demographics

After cleaning and coding, the FY2010 cohort data set has 144,245 observations representing four active duty military branches. Similar to the FY2005 cohort, the Army has the highest frequency of observations, with 61,548 representing 42.67% of all observations. The Navy has the second highest frequency of observations with 30,971, or 21.47% of the total, while the Air Force and Marine Corps are nearly the same with 25,795 and 25,931, respectively, as

shown in Table 8. Again, males make up a majority of the cohort observations at 121,448 or 84.20%, but the percentage of females has increased from 14.70% in FY2005 to 15.80% in FY2010. Unlike the FY2005 cohort, the Navy has the highest percentage of females with 21.30%, while the Marine Corps still has the lowest percentage at 8.40%. The Army has the highest percentage of Blacks with 17.78%, growing by over 3% since FY2005, and the Navy has the highest percentage of Hispanics with 15.41%, growing from 0% in FY2005.

Table 8. FY2010 Cohort Gender Representation by Service

	Gender			
Service	**Male**	**Female**	**Total**	**Percent Female**
Army	52,278	9,270	61,548	15.06%
Air Force	21,043	4,752	25,795	18.42%
Marines	23,754	2,177	25,931	8.40%
Navy	24,373	6,598	30,971	21.30%
Total	121,448	22,797	144,245	15.80%

The Army again had the highest average enlisted recruit age at 21.56, but the Navy is close with 21.00, and the Marine Corps again has the lowest average enlisted recruit age at 19.42 years old. Average AFQT scores rose within all services with the exception of the Army, where scores stayed around an average of 59. The Air Force average AFQT score grew by 4 points to 70.33, the Navy average AFQT score grew by 5 points to 67.85, and the Marine Corps average AFQT score grew by 2 points to 62.51. Figure 10 shows the frequency distribution of AFQT scores by gender for all services, and like the FY2005 cohort, shows a significant number of females scoring around the average and fewer around the high end compared to males. Figures 11–14 show the frequency distribution of AFQT scores by gender for each individual service branch. Like Figure 10, these figures also show that in each service, most females scored around the average while few scored in the upper categories. It is again interesting to note that the Army had the highest average enlisted recruit

age as well as the highest percentage of married individuals at 22.72%, with the Marine Corps again having the lowest average enlisted recruit age and the lowest married percentage at 7.03%, as shown in Table 9.

Figure 10. FY2010 AFQT Distribution by Gender for All Services

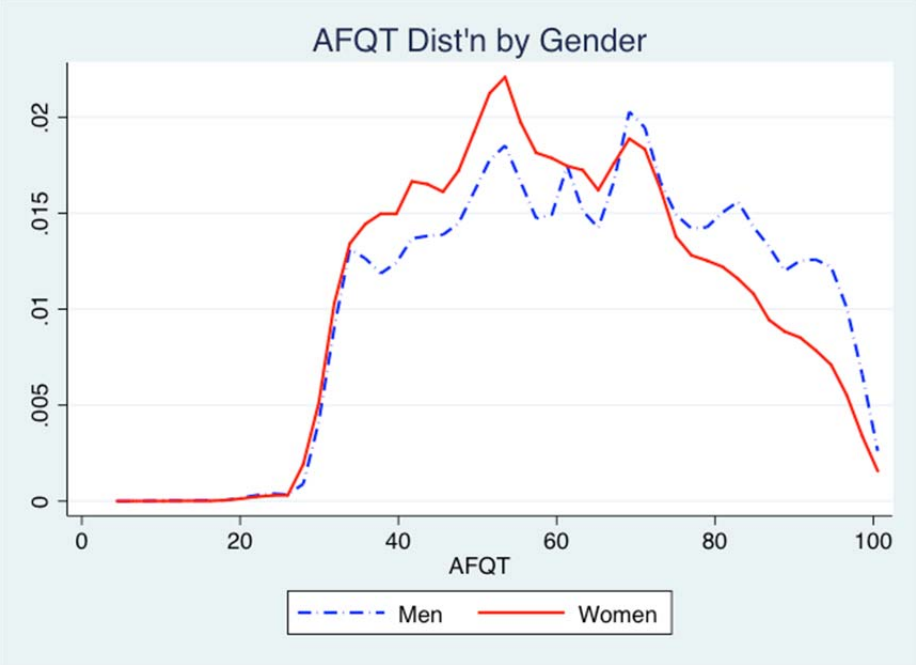


Figure 11. FY2010 AFQT Distribution by Gender for the Navy

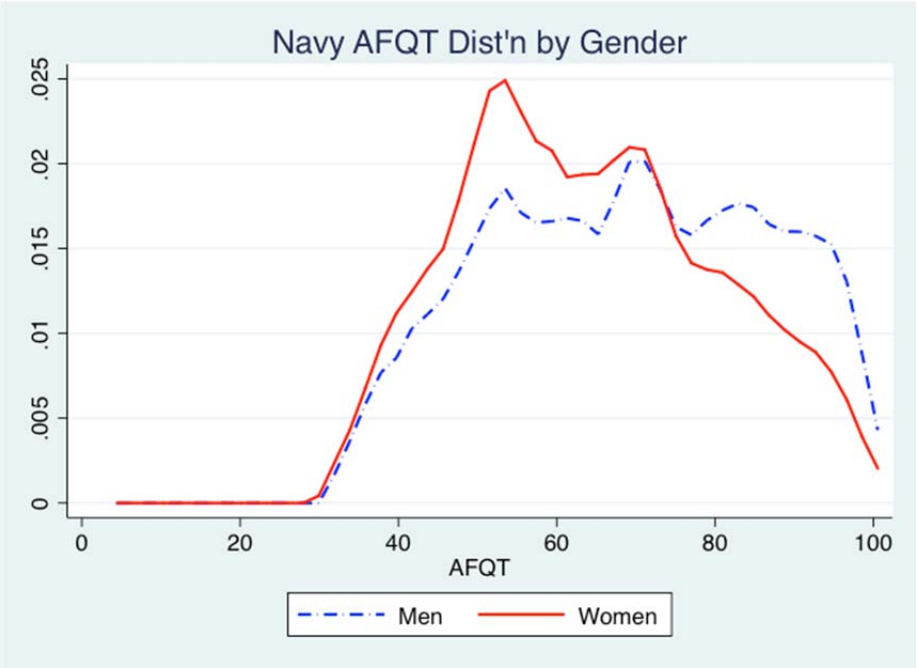


Figure 12. FY2010 AFQT Distribution by Gender for the Marine Corps

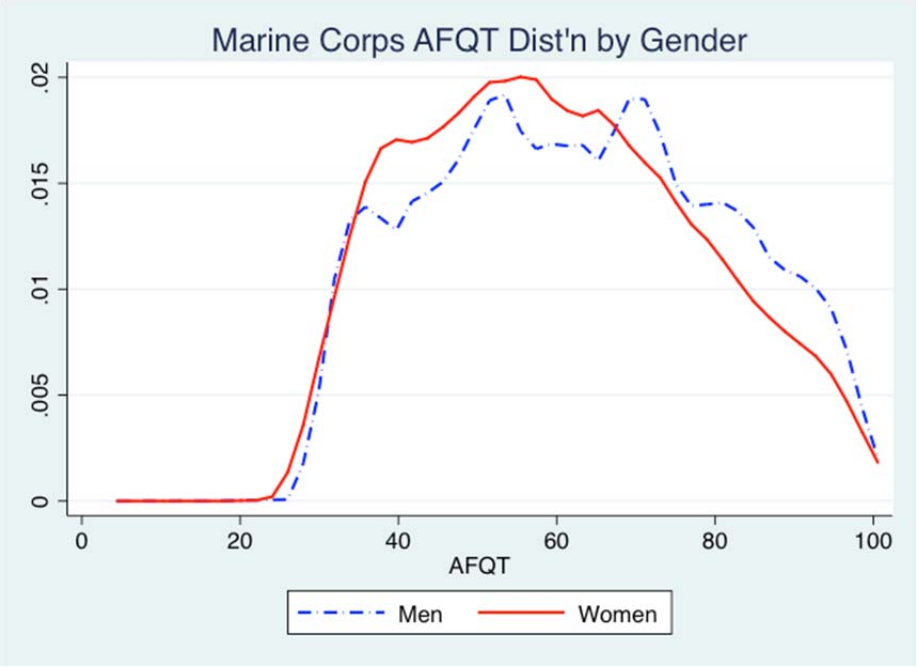


Figure 13. FY2010 AFQT Distribution by Gender for the Army

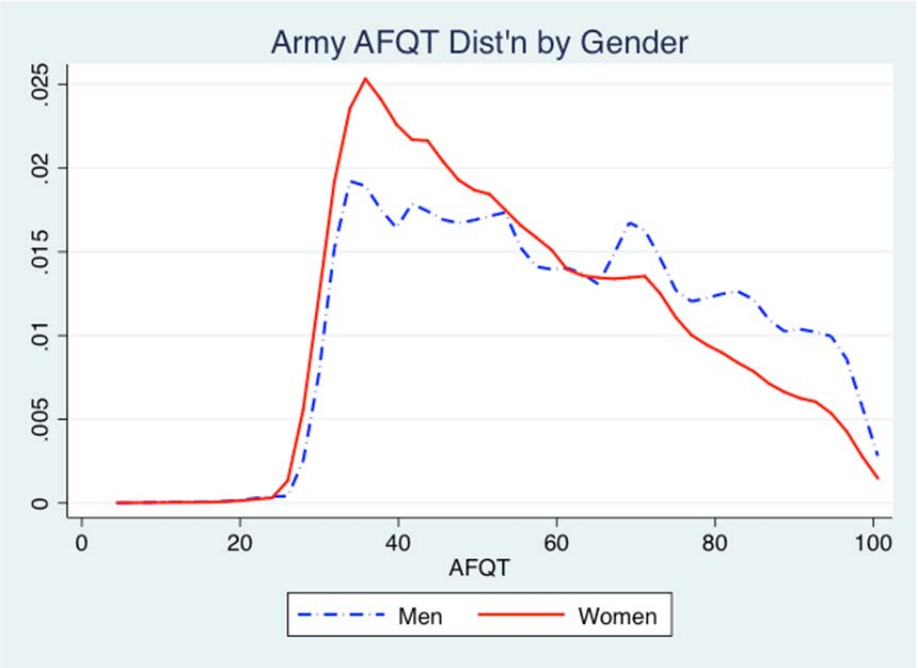


Figure 14. FY2010 AFQT Distribution by Gender for the Air Force

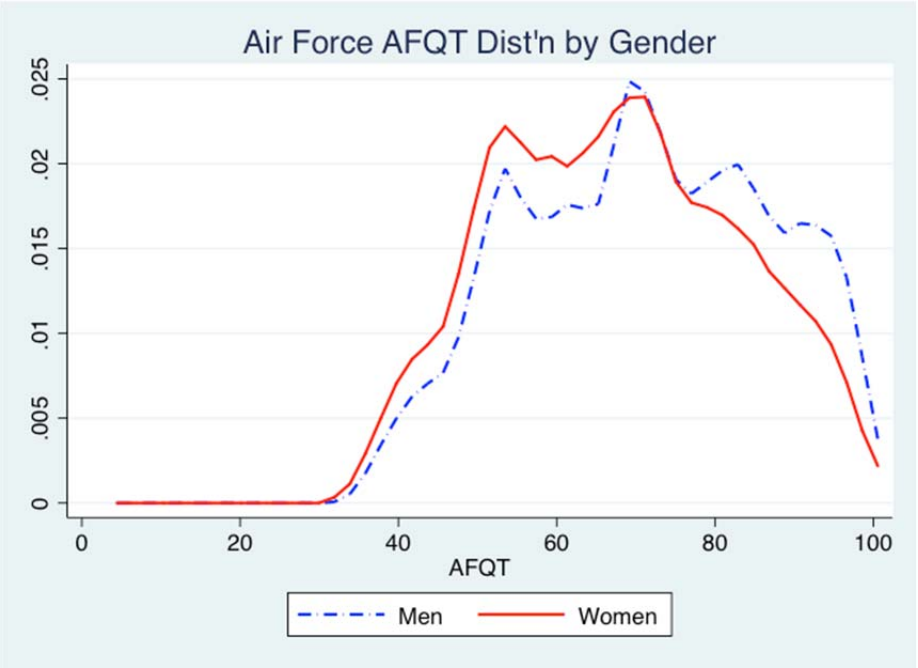


Table 9. FY2010 Cohort Summary Statistics

	Variable	N	Mean	SD
Army	Female	61548	0.15	0.36
	Age	61548	21.56	4.23
	Black	61548	0.18	0.38
	Hispanic	61548	0.12	0.33
	Married	61548	0.23	0.42
	AFQT	61548	59.75	19.51
Air Force	Female	25795	0.18	0.39
	Age	25795	20.28	2.26
	Black	25795	0.16	0.37
	Hispanic	25795	0.00	0.06
	Married	25795	0.17	0.37
	AFQT	25795	70.33	15.65
Marines	Female	25931	0.08	0.28
	Age	25931	19.42	1.98
	Black	25931	0.09	0.29
	Hispanic	25931	0.11	0.31
	Married	25931	0.07	0.26
	AFQT	25931	62.51	18.12
Navy	Female	30971	0.21	0.41
	Age	30971	21.01	3.07
	Black	30971	0.16	0.36
	Hispanic	30971	0.15	0.36
	Married	30971	0.14	0.35
	AFQT	30971	67.85	17.17

E. METHODOLOGY

Using different regression techniques, I estimate the impact of different individual characteristics on the decision to leave for both the FY2005 and FY2010 cohorts. I run the analysis separately for the two cohorts. The main OLS equation I estimate is represented as follows:

$$y_i = x_i\beta + d_i y_i + \varepsilon_i \quad (1)$$

The dependent variable for both cohorts is Loss Cohort, and I gradually add explanatory variables such as female, AFQT, education, demographic information and service. I use the dependent variable Loss Service when looking at interactions between the female variable and AFQT and the female variable and marriage. In all OLS regressions I include an interaction between an individual's home of record and year to control for any changes in the states unemployment rate that might influence an individual's decision to leave.

After an analysis of the OLS equations, I look at the frequency distribution of loss by cohort and gender. I then conduct a survival analysis of each cohort, looking at a Cox proportional hazards model as well as hazard ratios. I use the basic proportional hazards assumption represented by

$$h_i(t) = h_o(t) * \exp\{\beta_1 x_{i1} + \beta_2 x_{i2} + \ldots + \beta_k x_{ik}\} \quad (2)$$

I assume that the hazard for individual, i, is a function of two parts: the baseline hazard function, $h_o(t)$, which is the same for all individuals in the population, and the covariates, which is an exponent of the explanatory variables.

F. HYPOTHESIS

I expect that these regressions will validate previous research findings where female loss was higher than male loss. While previous research focused on Navy loss only, I expect that my results will show lower female retention across all services. I do expect to find a correlation between an individual having a higher AFQT and having higher education qualifications resulting in higher loss. While previous research did not explore interactions between females and variables I will explore these interactions for possible heterogeneous effects by gender.

V. ANALYSIS AND RESULTS

A. INTRODUCTION

In this chapter, I conduct an analysis of both loss and promotion for the FY2005 and FY2010 cohorts, specifically looking at gender differences among the services and differences in first-term loss between cohorts. I then analyze OLS models of loss and high-quality female loss. I finish with a survival analysis by estimating Cox Proportional Hazard models for both cohorts.

B. LOSS

In the next two sections I take a look at the first-term and overall loss rates among the services for the FY2005 and FY2010 cohorts.

1. FY2005 Cohort Loss

Using a linear fit of the data in Table 10, Figure 15 shows that the FY2005 cohort first-term female loss, or loss in the first four years of service, starts off slightly more than .02 points higher than males but quickly tapers off until it meets overall male loss by 2010. In the second term, or the next four years of service, male loss continues to rise while overall female loss steadily falls. Table 10 further illustrates that loss among all services peaks in 2009 with double-digit percentages among all branches of service and both genders. This pattern is possibly due to the increase of Army and Marine Corps troops to Afghanistan in 2009. At the same time, both the Navy and Air Force were seeing increased deployments to the Arabian Gulf in support of the increased troops to Afghanistan. Table 10 and Figure 16 present the results for the individual services where overall loss in the Marine Corps and Air Force rose throughout both the first and second terms, while Army loss fell slightly and Navy loss fell at a faster pace. While the Army's overall loss rate slows at a moderate rate in the 10-year period covered in this data set, the female loss rate went from being the highest among services in the first three years to the lowest among services in

the final year. Interestingly, when looking at the overall loss of the FY2005 cohort in Figure 16, the overall Air Force and Marine Corps loss is on a steady rise throughout the subsequent 10 years, but looking at Figure 17, one sees that overall female loss in both of those services was on a steady decline. This suggests that the rate of male loss is outpacing the rate of female loss in those two services.

2. FY2010 Cohort Loss

The data in Table 11 shows first-term loss for all services in the FY2010 cohort. Female loss across the services was slightly higher than male loss, with male loss edging higher in 2013 and 2014, as seen in the linear fit in Figure 18, perhaps following the pattern seen in the FY2005 cohort where female loss slows significantly after the first-term. Figure 19 shows the total cohort loss across services, with personnel in the Marine Corps leaving at a higher rate than the other services. Navy, Army, and Air Force loss were all rising at a similarly steady pace. Female loss in the FY2010 cohort, as shown in Figure 20, was rising at almost the same pace as overall loss. The only deviation from the overall rate was among the Army and Navy female loss, with Navy female loss rates growing at a faster pace than Army attrition. Similar to FY2005 results, double-digit loss rates dominate at the end of the first-term, seen in year 2014 in Table 11; the double-digit loss is across all services and genders, mirroring the results in the FY2005 cohort data set in 2009. It is worth noting that the first-term loss for both males and females in the Marine Corps was 9–10% higher in FY2010 than it was in FY2005, perhaps an effect of the drawn-out war or a reflection of the improved outlook on the economy in 2014 as opposed to 2009. Another noteworthy data point is the difference in Navy female first-term loss between the FY2005 and FY2010 cohorts; the FY2005 cohort had a 19% attrition rate in 2009 compared to a 26% attrition rate in 2014, again either reflecting a weariness in operation tempo (optempo) or a better outlook on the improving economy in 2014. While the year four mark also signifies the end of active obligated service (EAOS) where service members decide whether to sign

another contract or leave the active services, I am not distinguishing between the attrition or separation at EAOS in my regressions, solely looking at overall loss.

Table 10. FY2005 Mean Cohort Loss by Service and Gender

Service and Gender	Year									
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Army										
Male	0	0.08	0.07	0.1	0.15	0.11	0.08	0.07	0.07	0.04
Female	0	0.17	0.14	0.11	0.13	0.09	0.06	0.06	0.05	0.03
Air Force										
Male	0	0.07	0.05	0.04	0.16	0.05	0.1	0.03	0.04	0.06
Female	0	0.1	0.08	0.06	0.18	0.05	0.08	0.03	0.06	0.05
Marines										
Male	0	0.07	0.04	0.04	0.38	0.17	0.02	0.02	0.07	0.05
Female	0	0.11	0.06	0.03	0.36	0.14	0.02	0.02	0.08	0.04
Navy										
Male	0	0.09	0.1	0.06	0.19	0.1	0.08	0.03	0.06	0.02
Female	0	0.11	0.09	0.07	0.19	0.1	0.09	0.05	0.07	0.02

Figure 15. FY2005 Cohort Linear Fit Loss by Gender

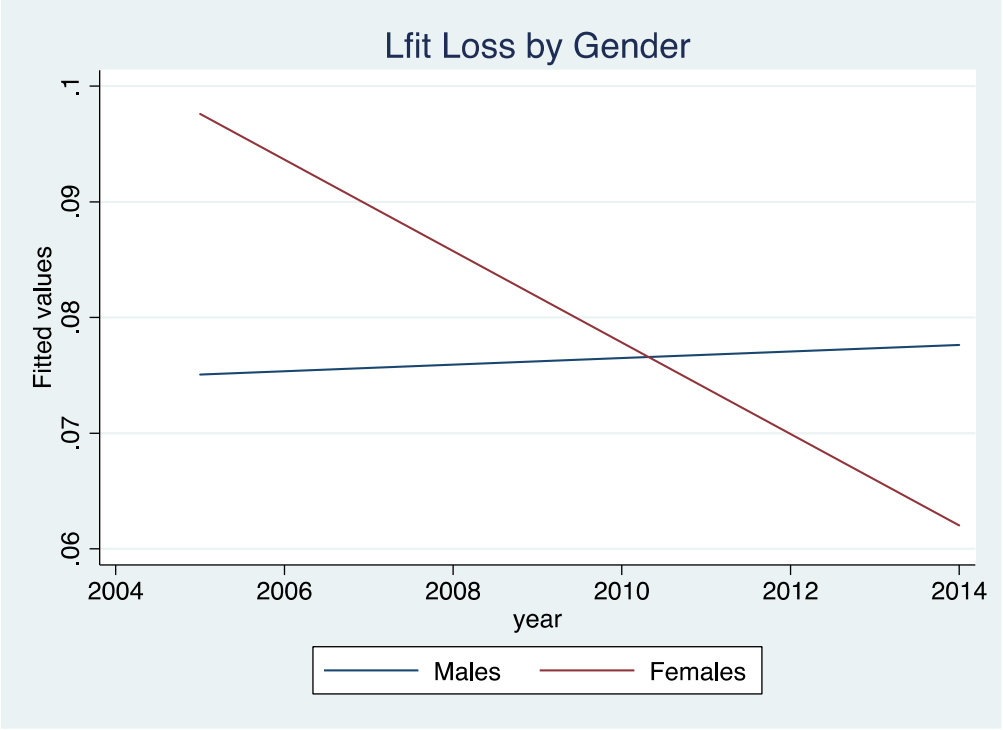


Figure 16. FY2005 Cohort Linear Fit Loss by Service

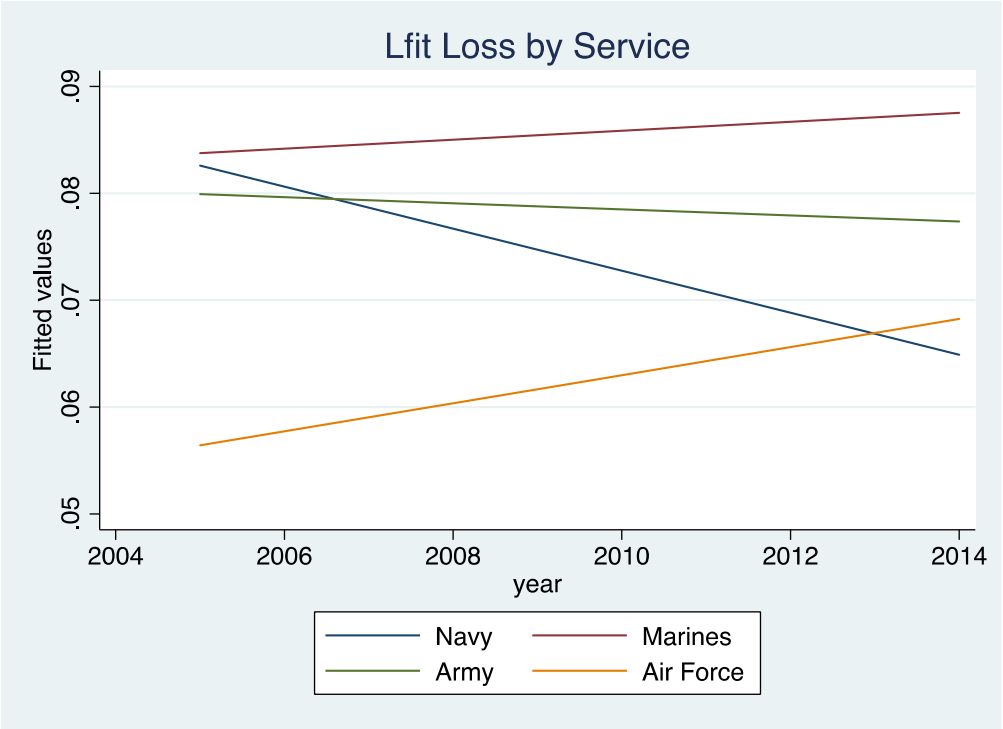


Figure 17. FY2005 Cohort Linear Fit Female Loss by Service

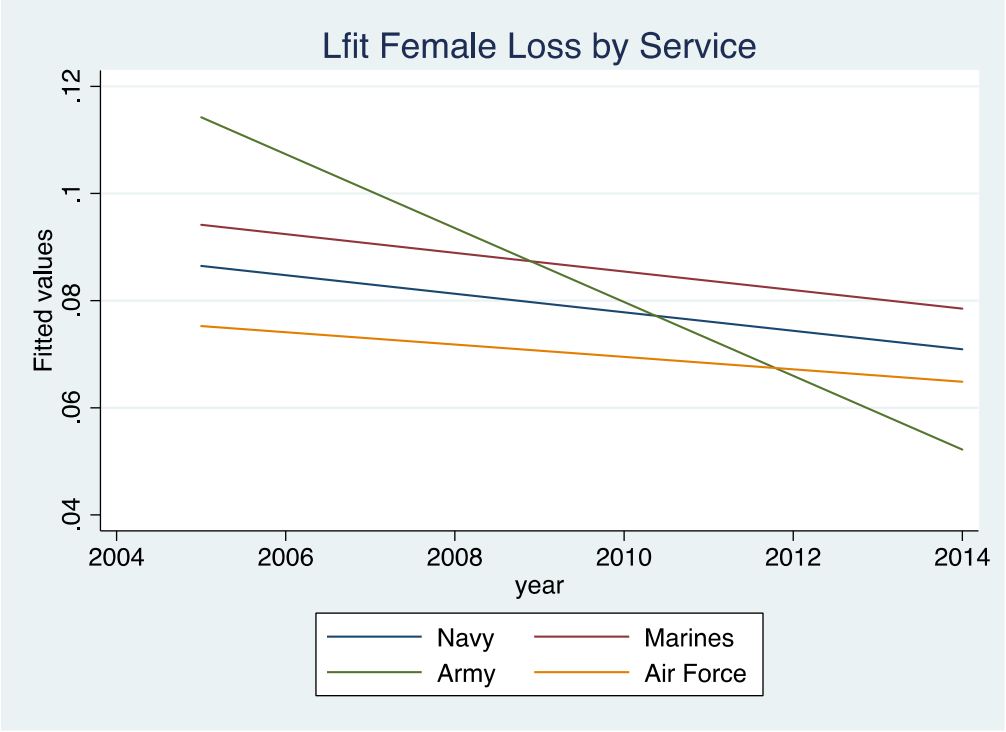


Table 11. FY2010 Mean Cohort Loss by Service and Gender

Service and Gender	Year				
	2010	2011	2012	2013	2014
Army					
Male	0	0.06	0.07	0.2	0.2
Female	0	0.12	0.1	0.17	0.18
Air Force					
Male	0	0.06	0.06	0.06	0.15
Female	0	0.08	0.07	0.07	0.15
Marines					
Male	0	0.04	0.04	0.06	0.46
Female	0	0.06	0.04	0.07	0.45
Navy					
Male	0	0.05	0.05	0.05	0.19
Female	0	0.07	0.06	0.08	0.26

Figure 18. FY2010 Cohort Linear Fit Loss by Gender

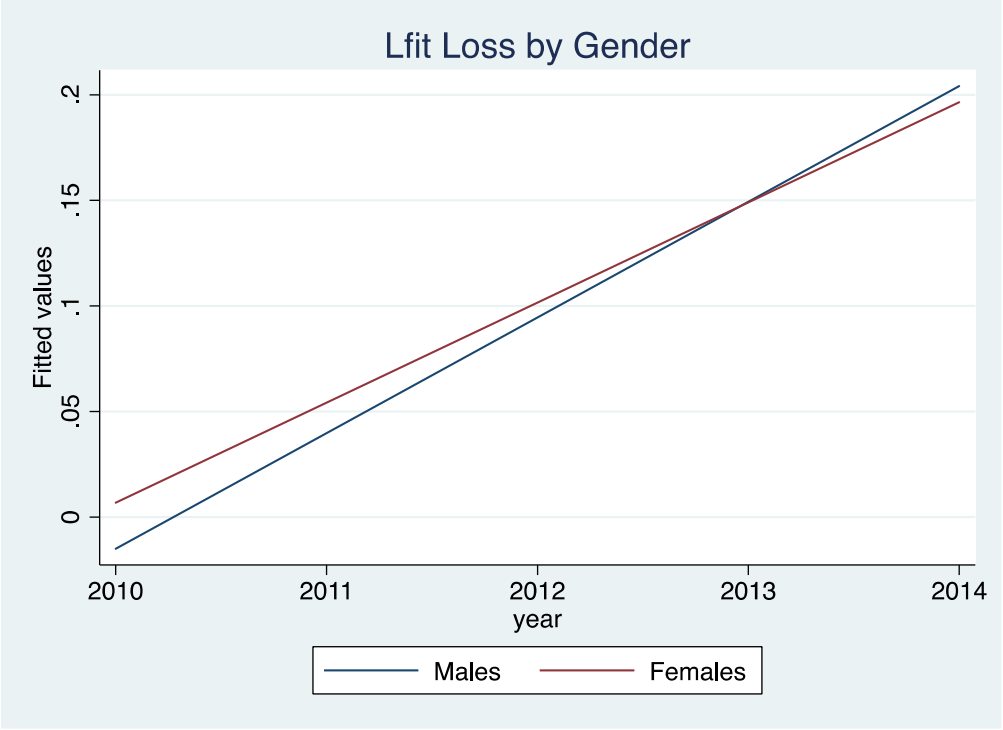


Figure 19. FY2010 Cohort Linear Fit Loss by Service

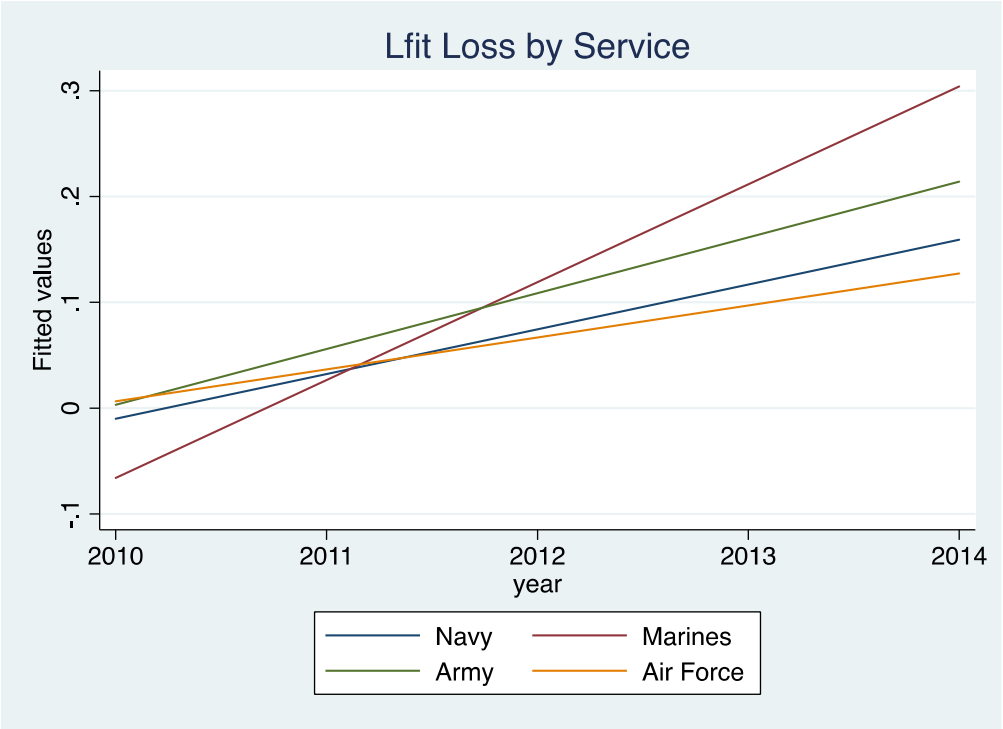
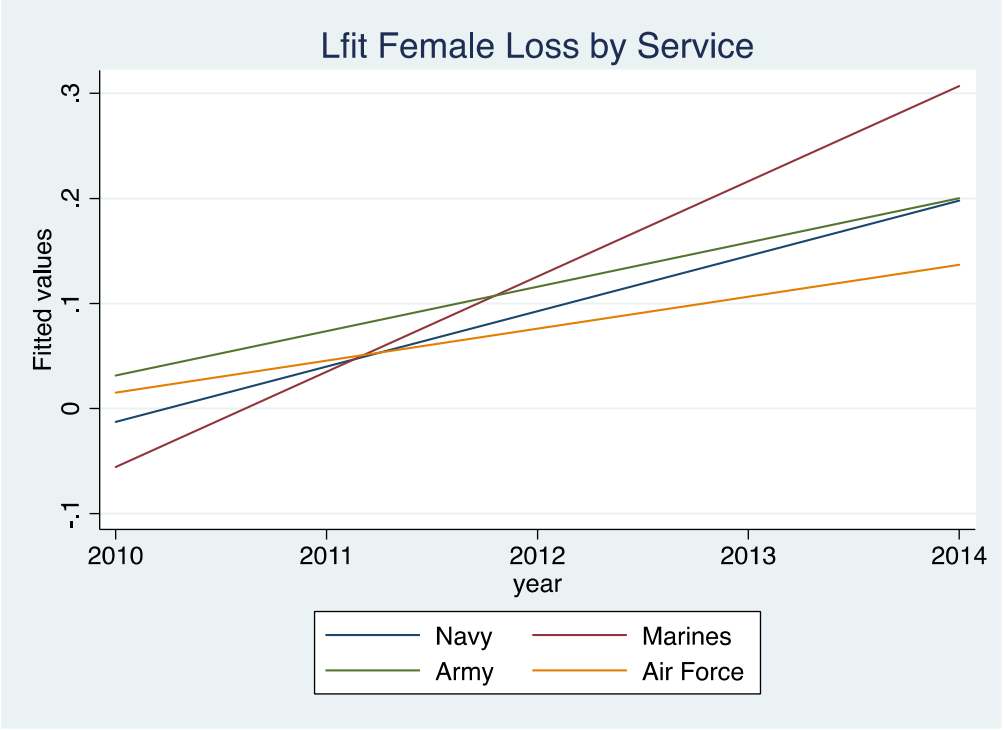


Figure 20. FY2010 Cohort Linear Fit Female Loss by Service



C. PROMOTION

When looking at mean promotion data in Tables 12 and 13 for the FY2005 and FY2010 cohorts, respectively, the highest promotion rates are seen in the first eligible year. This is usually what is called a “push button” promotion in the lower rankings, symbolizing the graduation from boot camp and a promotion from E1 to E2, E2 to E3, or E3 to E4. The Navy and Marine Corps have the highest initial promotion with, 50%–60% of all enlisted recruits being promoted that first year. Air Force and Army enlisted were promoted at around 30%, with the exception being the Air Force in the FY2010 cohort promoting 18% in 2011. The Air Force also promoted almost 50% in 2012, possibly signifying a policy change. This is illustrated further in Figures 22 and Figure 25, in which Air Force promotions were normalized in FY2005 but flat through FY2010.

The most salient finding for this research is that females are promoted at a slower rate than their male counterparts until the later years, when females promote at the same rate, or even a slightly higher rate, than males, as seen in

Figure 21. Further illustrating this point is Figure 24, where the gap is more apparent in the short run using the FY2010 cohort. Average Navy and Marine Corps female promotions are very similar between FY2005 and FY2010. Figures 23 and Figure 26 show that Army promotion of females is lagging behind all other services with the exception of FY2010, when both male and female promotions are stalled in the Air Force for the first two years. Subsequently, however, the gap between female promotions gets larger, and the Army again has the lowest percentage of females promoted.

Table 12. FY2005 Mean Cohort Promotion by Service and Gender

Service and Gender	Year								
	2006	2007	2008	2009	2010	2011	2012	2013	2014
Army									
Male	0.35	0.56	0.19	0.14	0.09	0.06	0.05	0.04	0.03
Female	0.31	0.43	0.14	0.09	0.07	0.04	0.03	0.03	0.02
Air Force									
Male	0.33	0.39	0.54	0.16	0.23	0.13	0.05	0.03	0.03
Female	0.42	0.43	0.5	0.11	0.19	0.12	0.04	0.02	0.02
Marines									
Male	0.58	0.44	0.34	0.18	0.07	0.05	0.02	0.02	0.02
Female	0.54	0.43	0.27	0.18	0.08	0.05	0.02	0.02	0.03
Navy									
Male	0.57	0.45	0.33	0.18	0.08	0.07	0.07	0.06	0.04
Female	0.55	0.45	0.3	0.19	0.09	0.06	0.06	0.05	0.04

Figure 21. FY2005 Cohort Linear Fit Promotion by Gender

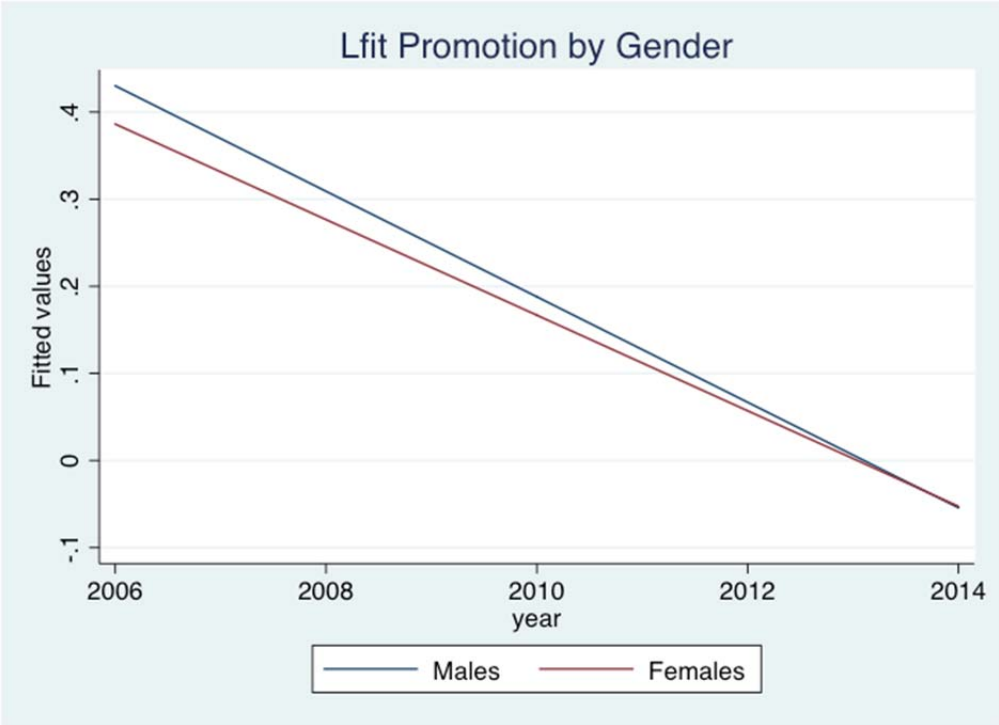


Figure 22. FY2005 Cohort Linear Fit Total Promotion by Service

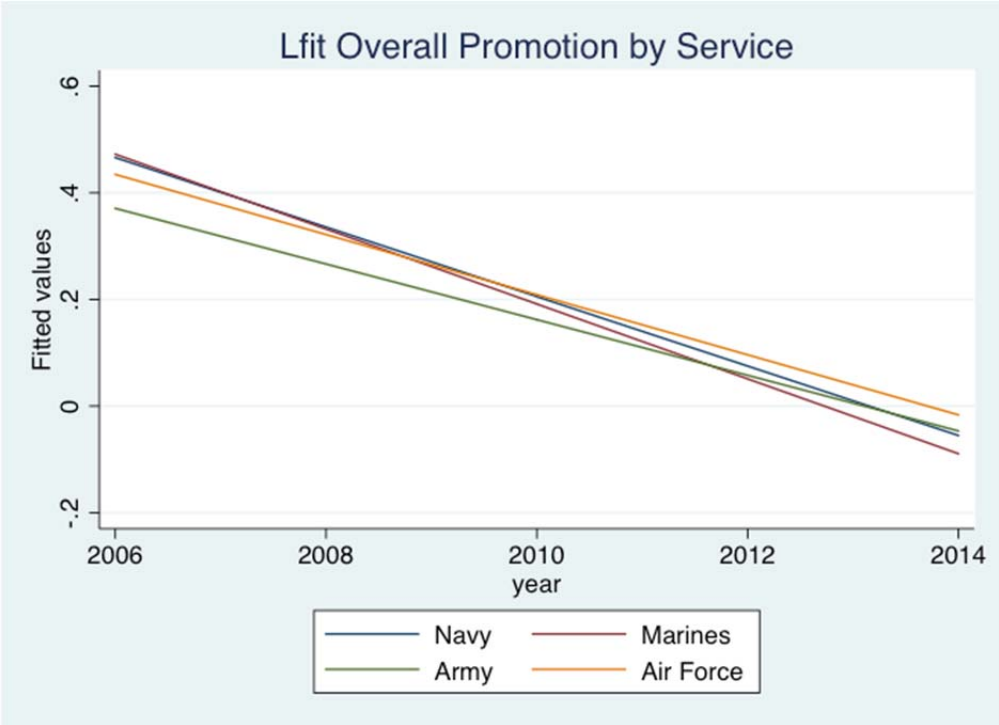


Figure 23. FY2005 Cohort Linear Fit Female Promotion by Service

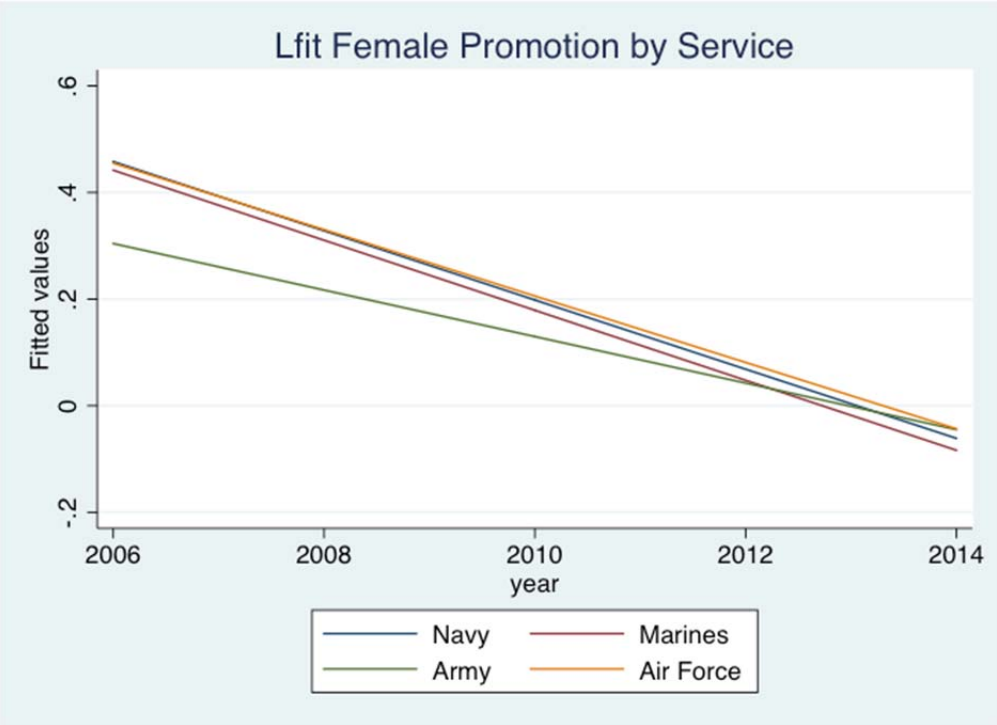


Table 13. FY2010 Mean Cohort Promotion by Service and Gender

Service and Gender	Year			
	2011	2012	2013	2014
Army				
Male	0.41	0.62	0.14	0.11
Female	0.35	0.54	0.11	0.09
Air Force				
Male	0.18	0.47	0.4	0.15
Female	0.18	0.49	0.35	0.12
Marines				
Male	0.64	0.37	0.42	0.2
Female	0.62	0.39	0.39	0.19
Navy				
Male	0.55	0.44	0.39	0.23
Female	0.54	0.45	0.38	0.19

Figure 24. FY2010 Cohort Linear Fit Promotion by Gender

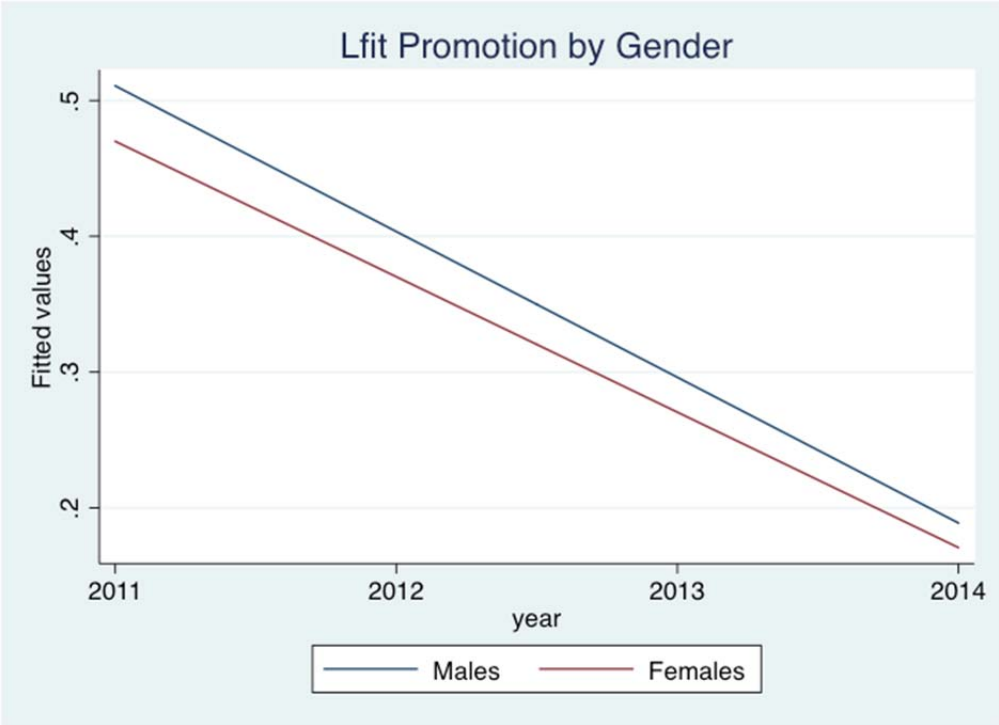


Figure 25. FY2010 Cohort Linear Fit Total Promotion by Service

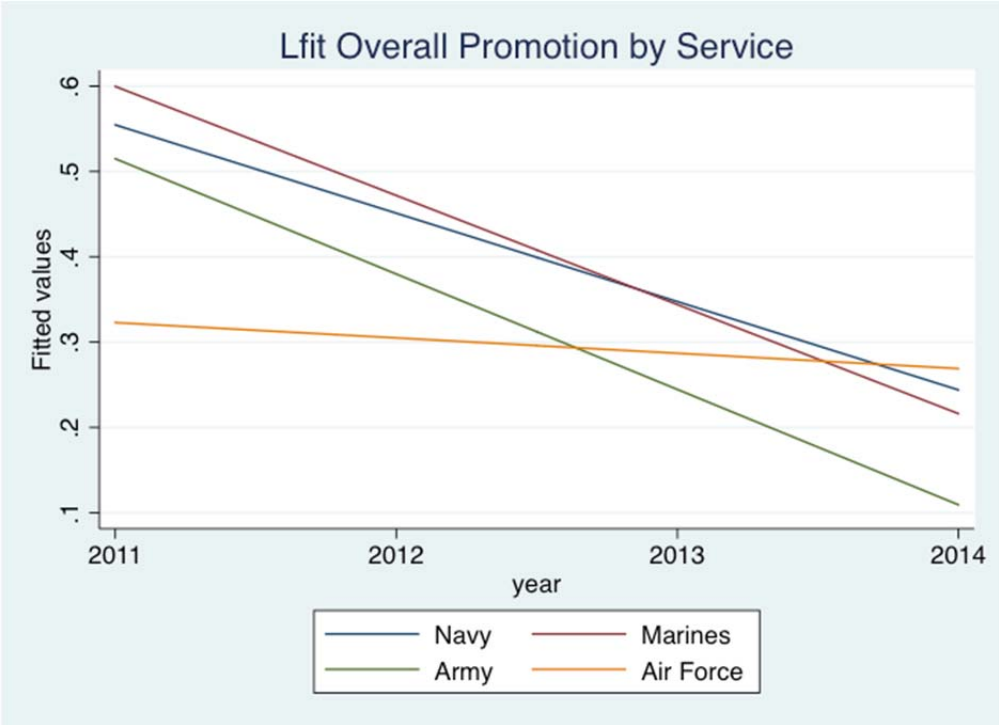
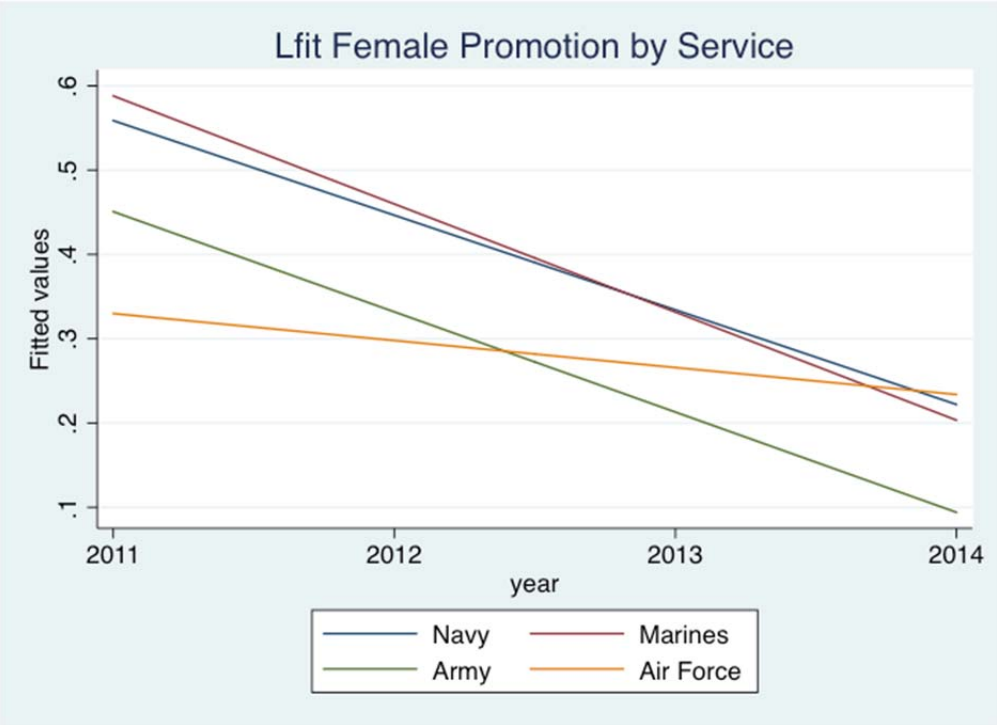


Figure 26. FY2010 Cohort Linear Fit Female Promotion by Service



D. REGRESSION RESULTS

Table 14 and Table 15 present the regression results for four different OLS models for the FY2005 cohort. Table 14 contains the results for the overall loss for FY2005, while Table 15 contains the results for first-term loss, or loss in the first four years, which allows a comparison of the FY2005 and FY2010 cohort results. Looking at OLS Model 4, all variables are significant at the 1% level for both Table 14 and Table 15. Both tables also show that among the FY2005 cohort, females were 6.71% more likely to leave the service overall and 9.16% more likely to leave in the first-term. Meanwhile, a higher AFQT score was associated with lower loss. Also, only having a GED or alternate high school certificate had a higher positive effect on loss than being a high school graduate or college graduate. This suggests that, holding everything else constant, high ability enlistees (as measured by the AFQT) and those with better educational qualifications are more likely to stay. Being Black, Hispanic, or married was negatively correlated with overall loss, showing that minorities and those who

enlist while married also tend to stay. Enlisting in the Marine Corps has the highest effect on loss in both the first-term and overall, with enlisting in the Army slightly behind by 6 percentage points (ppt) in both the first-term enlistment loss and overall loss.

Table 16 presents the regression results for four different OLS models for the FY2010 cohort. All variables in Model 4 are significant at the 1% level with the exception of college degree, which is significant at the 10% level. Results show that females were 6.31% more likely to leave compared to males. Holding all else constant, the effect of gender differences on first-term loss is actually lower in the FY2010 cohort than the FY2005 cohort, but almost the same for the overall loss rate for FY2005. Similar to the FY2005 cohort, a higher AFQT score has a slight negative effect, and only having a GED or alternate high school certificate has a higher effect than having either a high school or college degree. Being Black, Hispanic, or married also has a negative effect on loss.

Both Army and Marine Corps loss rates were higher in the first-term for the FY2010 cohort than the FY2005 cohort: 19.5% more likely to leave in the first-term versus 7.24% more likely to leave first-term for Army. Marines were 23.3% more likely to leave first-term of FY2010 versus 18.3% more likely to leave first-term of FY2005. Navy first-term loss was lower in FY2010 than it was in FY2005, 3.68% more likely to leave in the first-term versus 9.04% more likely to leave in the first-term of FY2005. These multivariate findings are consistent with the earlier descriptive analysis.

Using Model 4, predicted probabilities were estimated for both the FY2005 and FY2010 cohorts. In FY2005, a 20-year-old unmarried female with a high school diploma and an AFQT score of 50 (Category IIIA) in the Navy was 92.7% likely to leave overall and 62.15% likely to leave in the first-term. A similar female in the Army was 93.73% likely to leave overall and 59.68% likely to leave in the first-term, and a Marine was 100% likely to leave overall and 69.94% likely to leave in the first-term. In FY2010, a 20-year-old unmarried female with a high school diploma and an AFQT score of 50 (Category IIIA) in the Navy was 60.74%

likely to leave overall. A similar female in the Army was 69.16% likely to leave overall, and a Marine was 77.19% likely to leave overall. These predicted probabilities reflect the earlier findings that female first-term loss was declining in the Navy but on the rise in the Army and Marine Corps.

Table 14. OLS Regression Results for FY2005 Cohort Overall Loss

	(1)	(2)	(3)	(4)
VARIABLES				
female	0.0371***	0.0375***	0.0456***	0.0671***
	[0.00103]	[0.00103]	[0.00103]	[0.00103]
afqt		-0.000549***	-0.000797***	-0.000405***
		[1.98e-05]	[2.03e-05]	[2.02e-05]
highschool		0.0100***	0.00745***	0.0158***
		[0.00174]	[0.00174]	[0.00173]
ged_alt		0.0708***	0.0707***	0.0586***
		[0.00208]	[0.00208]	[0.00205]
college_deg		0.0156***	0.0343***	0.0380***
		[0.00305]	[0.00310]	[0.00306]
age			-0.00206***	-0.00212***
			[0.000135]	[0.000135]
married			-0.0675***	-0.0621***
			[0.00114]	[0.00112]

	(1)	(2)	(3)	(4)
black			-0.0748***	-0.0604***
			[0.00113]	[0.00112]
hispanic			0.00353**	-0.0341***
			[0.00147]	[0.00147]
navy				0.117***
				[0.00124]
marines				0.231***
				[0.00129]
army				0.167***
				[0.00120]
Constant	0.763***	0.782***	0.858***	0.679***
	[0.000394]	[0.00214]	[0.00346]	[0.00358]
Observations	1,340,520	1,340,520	1,340,520	1,340,520
R-squared	0.004	0.006	0.013	0.038
Standard errors in brackets				
*** p<0.01, ** p<0.05, * p<0.1				

Table 15. OLS Regression Results for FY2005 Cohort First-term Loss

	(1)	(2)	(3)	(4)
VARIABLES				
female	0.0687***	0.0645***	0.0718***	0.0916***
	[0.00121]	[0.00121]	[0.00121]	[0.00122]
afqt		-0.00227***	-0.00253***	-0.00231***
		[2.32e-05]	[2.38e-05]	[2.39e-05]
highschool		0.0233***	0.0211***	0.00991***
		[0.00204]	[0.00204]	[0.00205]
ged_alt		0.0988***	0.0995***	0.0941***
		[0.00244]	[0.00244]	[0.00243]
college_deg		0.0128***	0.0242***	0.0139***
		[0.00358]	[0.00364]	[0.00362]
age			-0.000706***	0.000933***
			[0.000158]	[0.000160]
married			-0.0672***	-0.0583***
			[0.00133]	[0.00133]
black			-0.0610***	-0.0486***
			[0.00132]	[0.00132]
hispanic			-0.0276***	-0.0424***
			[0.00172]	[0.00174]

	(1)	(2)	(3)	(4)
navy				0.0904***
				[0.00147]
marines				0.183***
				[0.00153]
army				0.0724***
				[0.00141]
Constant	0.432***	0.543***	0.594***	0.462***
	[0.000464]	[0.00251]	[0.00406]	[0.00423]
Observations	1,340,520	1,340,520	1,340,520	1,340,520
R-squared	0.004	0.015	0.018	0.03
Standard errors in brackets				
*** p<0.01, ** p<0.05, * p<0.1				

Table 16. OLS Regression Results for FY2010 Cohort Overall Loss

	(1)	(2)	(3)	(4)
VARIABLES				
female	0.0393***	0.0283***	0.0358***	0.0631***
	[0.00162]	[0.00161]	[0.00161]	[0.00160]
afqt		-0.00360***	-0.00393***	-0.00276***
		[3.22e-05]	[3.31e-05]	[3.35e-05]
highschool		0.0127***	-0.00263	-0.00129
		[0.00233]	[0.00237]	[0.00234]
ged_alt		0.103***	0.0918***	0.0597***
		[0.00396]	[0.00396]	[0.00391]
college_deg		0.00765**	0.0219***	0.00767**
		[0.00375]	[0.00379]	[0.00374]
age			-0.00251***	-0.00332***
			[0.000198]	[0.000198]
married			-0.0676***	-0.0664***
			[0.00168]	[0.00166]
black			-0.0830***	-0.0698***
			[0.00175]	[0.00173]
hispanic			-0.0237***	-0.0357***
			[0.00204]	[0.00203]

	(1)	(2)	(3)	(4)
navy				0.0368***
				[0.00187]
marines				0.233***
				[0.00196]
army				0.195***
				[0.00169]
Constant	0.472***	0.690***	0.801***	0.606***
	[0.000643]	[0.00317]	[0.00533]	[0.00541]
Observations	714,630	714,630	714,630	714,630
R-squared	0.004	0.024	0.03	0.062
Standard errors in brackets				
*** p<0.01, ** p<0.05, * p<0.1				

Table 17 and Table 18 present regression results for four different OLS models for the FY2005 cohort, specifically focused on the interaction between the female and AFQT variables as well as the female and married variables. Table 17 presents the results for the Navy and Marine Corps and Table 18 presents the results for the Army and Air Force. Using the standard deviation of AFQT for the individual services in the FY2005 cohort shown in Table 7, results show that for every standard deviation increase in AFQT a female in the Navy was 1.48% more likely to leave while a female in the Marine Corps was 1.02% more likely to leave. A female in the Army is also 0.56% more likely to leave for

every standard deviation increase in AFQT and a female in the Air Force was 1.42% more likely to leave for every standard deviation increase in AFQT. These results show that when using AFQT as a proxy for ability, higher quality females in the FY2005 cohort, or females with higher AFQT scores and presumably higher ability, were more likely to leave the Navy, Army, Air Force and Marine Corps. A married female was 7.98% more likely to leave the Navy, 3.24% more likely to leave the Army and 9.13% more likely to leave the Air Force. Marriage had no significance on female loss in the Marine Corps.

Table 19 and Table 20 present regression results for four different OLS models for the FY2010 cohort, again focused on the interaction between the female and AFQT variables as well as the female and married variables. Table 19 presents the results for the Navy and Marine Corps while Table 20 presents the results for the Army and Air Force. Using the standard deviation of AFQT for the individual services in the FY2010 cohort shown in Table 9, results show that for every standard deviation increase in AFQT a female in the Navy was 1.04% more likely to leave and a female in the Army was 1.00% more likely to leave. Changes in AFQT had no statistically significant effect on female loss for the Marine Corps and Air Force. The consistency in likelihood of loss from the Navy and Army between the FY2005 cohort and the FY2010 cohort shows that higher quality females were consistently deciding to leave those services. Similar to the results from the FY2005 cohort, married females in the FY2010 cohort were more likely to leave the Navy and the Marine Corps, 4.11% and 10.70% respectively. Married females in the Army were 6.14% more likely to leave and married females in the Air Force were 11.30% more likely to leave.

Table 17. OLS Regression Results for FY2005 Navy and Marine Corps Female AFQT and Marriage Interactions

	(1)	(2)	(3)	(4)
VARIABLES	**loss_navy**	**loss_navy**	**loss_marines**	**loss_marines**
female	0.0587***	0.00363	0.00801***	-0.0206**
	[0.00211]	[0.00766]	[0.00263]	[0.00922]
afqt	-0.000774***	-0.00103***	-0.000243***	-0.000370***
	[4.26e-05]	[4.76e-05]	[3.57e-05]	[3.75e-05]
married	-0.0834***	-0.0866***	-0.0585***	-0.0531***
	[0.00257]	[0.00289]	[0.00263]	[0.00281]
female_afqt		0.000813***		0.000556***
		[0.000122]		[0.000150]
female_married		0.0798***		0.00832
		[0.00707]		[0.0100]
highschool		-0.0125***		0.0032
		[0.00424]		[0.00532]
ged_alt		0.0251***		0.0399***
		[0.00576]		[0.00597]
college_deg		-0.0205***		0.00772
		[0.00667]		[0.00988]
age		-0.00427***		-0.00297***
		[0.000314]		[0.000352]

	(1)	(2)	(3)	(4)
black		-0.0436***		-0.0474***
		[0.00212]		[0.00271]
hispanic		0.00537		-0.0241***
		[0.0118]		[0.00225]
Constant	0.785***	0.905***	0.875***	0.939***
	[0.00281]	[0.00824]	[0.00228]	[0.00914]
Observations	325,610	325,610	286,090	286,090
R-squared	0.011	0.014	0.006	0.008
Standard errors in brackets				
*** p<0.01, ** p<0.05, * p<0.1				

Table 18. OLS Regression Results for FY2005 Army and Air Force Female AFQT and Marriage Interactions

	(1)	(2)	(3)	(4)
VARIABLES	**loss_army**	**loss_army**	**loss_airforce**	**loss_airforce**
female	0.0597***	0.0484***	0.101***	0.0329***
	[0.00150]	[0.00478]	[0.00283]	[0.0120]
afqt	4.83e-05*	-0.000289***	-4.83E-05	-0.000343***
	[2.80e-05]	[3.18e-05]	[7.17e-05]	[8.22e-05]
married	-0.0585***	-0.0638***	-0.0779***	-0.0943***
	[0.00140]	[0.00164]	[0.00348]	[0.00409]
female_afqt		0.000284***		0.000866***
		[7.88e-05]		[0.000180]
female_married		0.0324***		0.0913***
		[0.00363]		[0.00811]
highschool		0.0264***		-0.0179**
		[0.00209]		[0.00811]
ged_alt		0.0693***		0.0829***
		[0.00241]		[0.0175]
college_deg		0.0618***		0.0335***
		[0.00393]		[0.0120]
age		-0.000756***		-0.00646***
		[0.000171]		[0.000619]

	(1)	(2)	(3)	(4)
black		-0.0855***		-0.0464***
		[0.00172]		[0.00344]
hispanic		-0.0438***		-0.0236
		[0.00185]		[0.0242]
Constant	0.785***	0.805***	0.614***	0.787***
	[0.00183]	[0.00445]	[0.00504]	[0.0159]
Observations	557,240	557,240	171,580	171,580
R-squared	0.009	0.016	0.015	0.018
Standard errors in brackets				
*** p<0.01, ** p<0.05, * p<0.1				

Table 19. OLS Regression Results for FY2010 Navy and Marine Corps Female AFQT and Marriage Interactions

	(1)	(2)	(3)	(4)
VARIABLES	**loss_navy**	**loss_navy**	**loss_marines**	**loss_marines**
female	0.0960***	0.0550***	0.0224***	-0.000176
	[0.00298]	[0.0122]	[0.00485]	[0.0174]
afqt	-0.00387***	-0.00407***	-0.00493***	-0.00512***
	[7.15e-05]	[8.17e-05]	[7.44e-05]	[7.91e-05]
married	-0.0488***	-0.0424***	-0.0491***	-0.0537***
	[0.00348]	[0.00403]	[0.00526]	[0.00565]
female_afqt		0.000606***		0.000291
		[0.000182]		[0.000278]
female_married		0.0411***		0.107***
		[0.00882]		[0.0195]
highschool		-0.00451		0.00962
		[0.00613]		[0.00868]
ged_alt		0.0627***		0.0122
		[0.00990]		[0.0120]
college_deg		-0.0239***		0.0691***
		[0.00845]		[0.0170]
age		-0.00539***		-0.00263***
		[0.000450]		[0.000732]

	(1)	(2)	(3)	(4)
black		-0.0565***		-0.0649***
		[0.00362]		[0.00482]
hispanic		-0.00518		-0.0306***
		[0.00357]		[0.00464]
Constant	0.622***	0.760***	0.905***	0.968***
	[0.00513]	[0.0127]	[0.00489]	[0.0178]
Observations	154,110	154,110	128,910	128,910
R-squared	0.034	0.038	0.038	0.04
Standard errors in brackets				
*** p<0.01, ** p<0.05, * p<0.1				

Table 20. OLS Regression Results for FY2010 Army and Air Force Female AFQT and Marriage Interactions

	(1)	(2)	(3)	(4)
VARIABLES	**loss_army**	**loss_army**	**loss_airforce**	**loss_airforce**
female	0.0456***	0.0146*	0.0530***	0.0325**
	[0.00253]	[0.00815]	[0.00340]	[0.0155]
afqt	-0.00151***	-0.00197***	-0.00117***	-0.000964***
	[4.67e-05]	[5.28e-05]	[8.48e-05]	[9.64e-05]
married	-0.0910***	-0.0932***	-0.0728***	-0.0795***
	[0.00216]	[0.00254]	[0.00354]	[0.00404]
female_afqt		0.000513***		2.57E-05
		[0.000136]		[0.000222]
female_married		0.0614***		0.113***
		[0.00584]		[0.00916]
highschool		0.00740**		-0.000616
		[0.00328]		[0.00459]
ged_alt		0.0831***		-0.00507
		[0.00507]		[0.0188]
college_deg		0.0109**		0.0183**
		[0.00500]		[0.00931]
age		-0.00180***		-0.00994***
		[0.000254]		[0.000649]

	(1)	(2)	(3)	(4)
black		-0.0920***		-0.0188***
		[0.00262]		[0.00381]
hispanic		-0.0627***		-0.00616
		[0.00303]		[0.0241]
Constant	0.648***	0.726***	0.419***	0.610***
	[0.00303]	[0.00741]	[0.00619]	[0.0146]
Observations	303,270	303,270	128,340	128,340
R-squared	0.017	0.024	0.012	0.015
Standard errors in brackets				
*** p<0.01, ** p<0.05, * p<0.1				

E. COX REGRESSION RESULTS AND SURVIVAL ANALYSIS

Table 21 and Table 22 present results for Cox Regression using the FY2005 and FY2010 cohorts, respectively. All regressors are statistically significant at the 1% level with the exception of the Hispanic variable in the FY2010 model, which is significant only at the 5% level. Exponentiation of the female coefficient in the FY2005 and FY2010 Cox Regression reveals hazard ratios of 1.18 and 1.08. This means females' risk for loss is 1.18 and 1.08 times greater than that of a male. Figures 28 and Figure 30 illustrate female "failure," or loss rates, being higher than males, as shown by the decreased survival rate over the period. For both cohorts, there is a large step in Year 4, which represents the end of first-term enlistment, or EAOS, and a large drop for both male and females. As the observation periods end, we can also see that the gap between female and male survival rates, and presumably hazard rates, close.

When looking across services using Figures 27 and Figure 29, the estimates also show the Army had the highest hazard ratio, while the Marine Corps had the lowest hazard ratio. However, the year 4 drop for the Marine Corps shows that while enlisted Marines were more likely to survive to the end of their first-term, they were also more likely to leave at that time. While Blacks have a hazard ratio of .967 in FY2005, they have a hazard ratio of 1.08 in FY2010. This means Blacks have an increased hazard and shorter survival time in FY2010 compared to a decreased hazard and longer survival time in FY2005. In contrast, Hispanics have a consistent negative coefficient and hazard ratio. These results show that in both the FY2005 and FY2010 cohorts, Hispanics have a consistently lower hazard, or likeliness of loss, while Blacks in the FY2010 cohort actually have a higher hazard, or likeliness of loss.

Table 21. FY2005 Cox Regression

	(1)
VARIABLES	
female	0.164***
	[0.00879]
navy	0.256***
	[0.0117]
marines	0.158***
	[0.0118]
army	0.201***
	[0.0109]
black	-0.0332***
	[0.00944]
hispanic	-0.0663***
	[0.012]
Observations	103,760
Standard errors in brackets	
*** p<0.01, ** p<0.05, * p<0.1	

Figure 27. FY2005 Kaplan–Meier Survival Estimates by Service

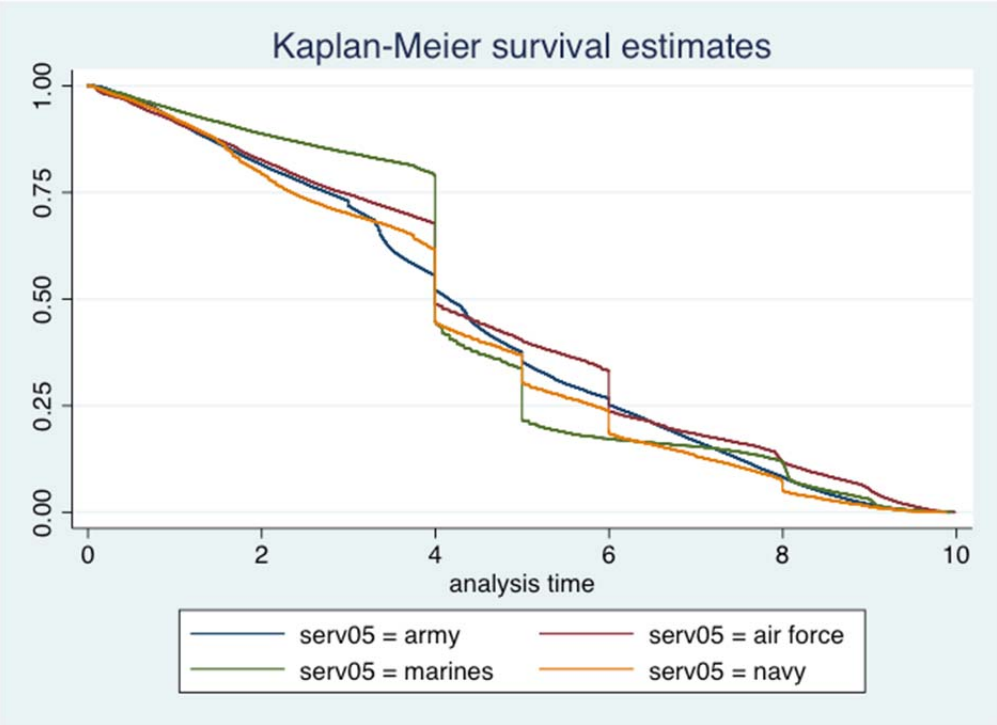


Figure 28. FY2005 Kaplan–Meier Survival Estimates by Gender

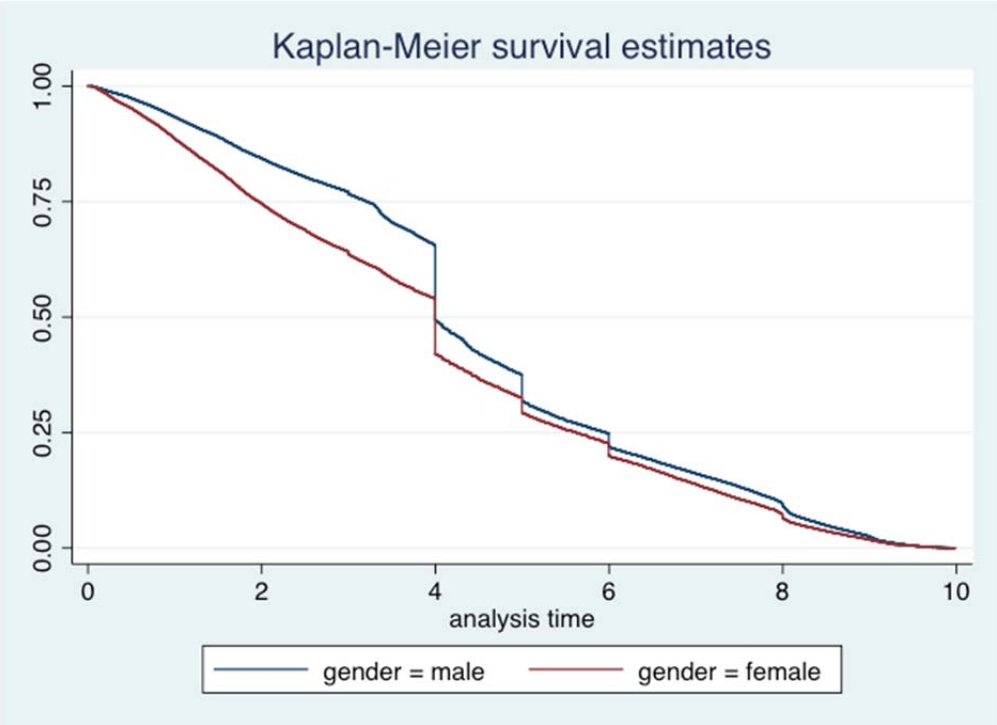


Table 22. FY2010 Cox Regression

	(1)
VARIABLES	
female	0.0773***
	[0.0104]
navy	-0.0549***
	[0.0145]
marines	-0.288***
	[0.0136]
army	0.297***
	[0.0123]
black	0.0778***
	[0.0111]
hispanic	-0.0297**
	[0.0126]
Observations	68,821
Standard errors in parentheses	
*** p<0.01, ** p<0.05, * p<0.1	

Figure 29. FY2010 Kaplan–Meier Survival Estimates by Service

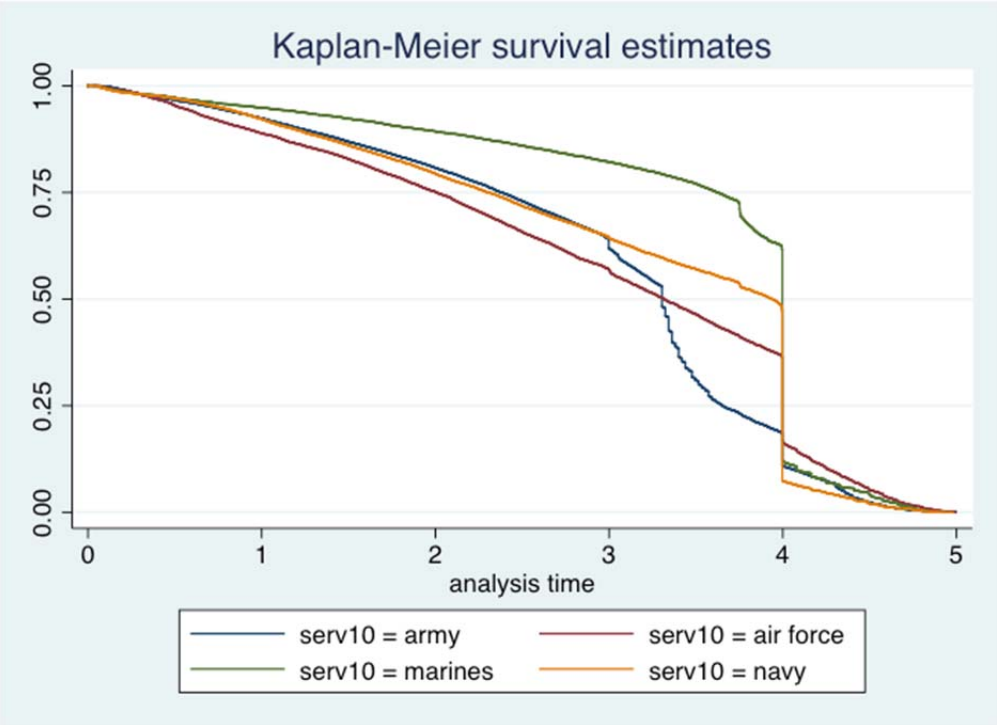
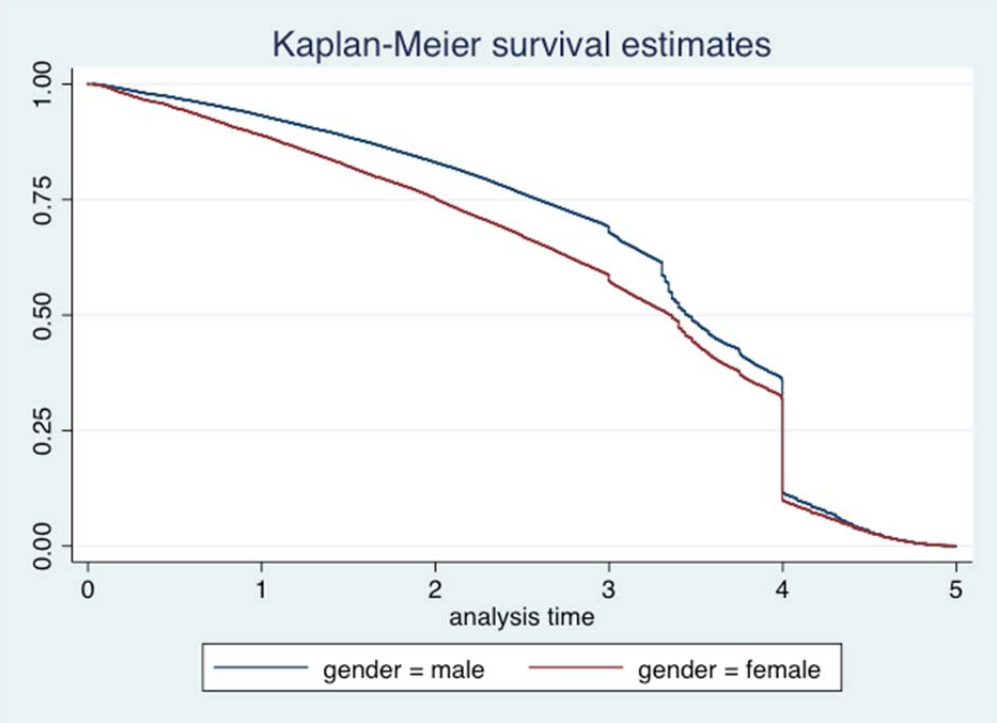


Figure 30. FY2010 Kaplan–Meier Survival Estimates by Gender



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VI. CONCLUSION

A. ANSWERS TO RESEARCH QUESTIONS

In this thesis, I analyze loss and promotion across services for the FY2005 and FY2010 cohorts. Using a linear probability model, I explore how demographic characteristics such as service, gender, age, and race impact loss and promotion. I also test for differential effects by gender for certain demographics such as marital status and AFQT scores, using the latter as a rough proxy for ability. I find that gender, race, marital status, and AFQT scores all impact loss.

While female loss was higher in the FY2010 cohort, regression results show that propensity for first-term loss for females was actually lower in FY2010 than it was in FY2005. Branch of service was the largest determinant of both first-term and overall loss, with first-term Army and Marine Corps loss higher in the FY2010 cohort than the FY2005 cohort. Navy loss was lower in the FY2010 cohort than the FY2005 cohort. I find that married individuals were less likely to leave during their first-term of service, as were individuals with higher AFQT scores. On the other hand, Blacks and Hispanics were less likely to leave overall.

Using the AFQT as a proxy for ability I find that higher quality females were more likely to leave in all branches of service than males in the FY2005 cohort. Higher quality females in the FY2010 cohort had a greater likelihood of leaving in the Navy and Army. Using an interaction between married and females I find that married females were more likely to leave in all branches of service than males and these results were seen in both the FY2005 and FY2010 cohorts.

Linear fit models show that females promote at a slower rate than males do across all services until the later years and higher paygrades. This finding was seen in both the FY2005 and FY2010 cohorts. While Navy and Marine Corps female promotions were very close percentage-wise for the FY2010 cohort, the Army and Air Force female promotions were significantly smaller.

B. RECOMMENDATIONS

When I look at the FY2005 cohort loss and see 79.81% of females leaving the service after nine years with 49.86% of those leaving within their first four years, it is obvious that we have a problem with female retention. This fact is further evident when I see that 50.82% of females in the FY2010 cohort left within their first four years.

In order to fulfill the goal of reaching 20% female representation by 2020, we need to ensure that the highest quality females are recruited *and* retained. We also need to ensure that the playing field is even for all service members, meaning promotions and career opportunities are equally available to both female and male service members. The decision to open all occupations and units on January 1, 2016, is a good step to leveling the playing field and telling women that they do have an equal opportunity in the military. The recent focus on expanding maternity leave as well as the career intermission program are good first steps to allowing women to balance family life with military life.

I recommend that the DOD continues to study why women are choosing to join the Armed Forces and why they are also deciding to leave. Further studies on female promotion need to be completed using career data as well as evaluation data to see if there is actually a gender-related problem with promotions or if it is a problem with work performance, motivation, or opportunity. Given the differences across the two cohorts, I also recommend studying first-term loss from previous cohorts to see if they follow the linear trends from the FY2005 and FY2010 cohorts.

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